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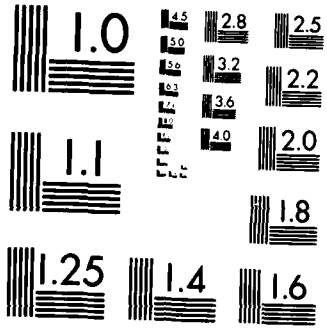

HOUSATONIC RIVER BASIN
WASHINGTON, MASSACHUSETTS

FARNHAM RESERVOIR DAM
MA 00314

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

FEBRUARY 1980

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Washington, Massachusetts
Mill Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is a concrete gravity dam 750 ft. long and about 105 ft. high. The dam is in POOR condition. It is large in size and has a high hazard potential. Failure of the dam will pose a serious threat to two houses and two water supply structures, as well as access to the road to the dam.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

DEC 9 1980

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Farnham Reservoir Dam (MA-00314) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, City of Pittsfield, Mass.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

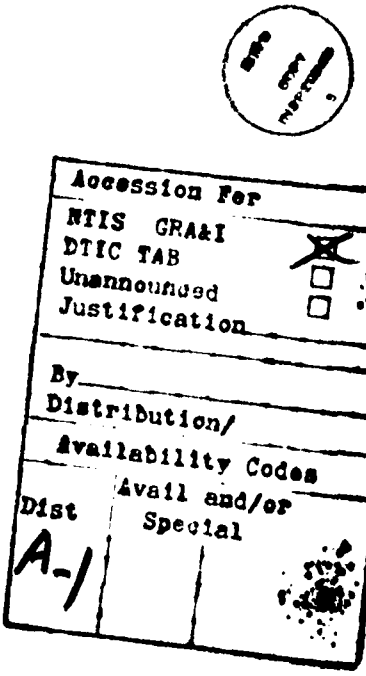
WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated

FARNHAM RESERVOIR DAM

MA 00314

HOUSATONIC RIVER BASIN
WASHINGTON, MASSACHUSETTS



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	MA 00314
Mass. DPW No.:	1-2-313-5
Name of Dam:	Farnham Reservoir Dam
Town:	Washington
County and State:	Berkshire County, Massachusetts
Stream:	Mill Brook
Date of Inspection:	November 7, 1979

BRIEF ASSESSMENT

Farnham Reservoir Dam is located in Washington, Massachusetts on Mill Brook a tributary to the Housatonic River. The dam is a concrete gravity dam 750 feet long and about 105 feet high. Near the center of the dam is a reinforced concrete ogee spillway 25 feet long and an intake and gate well with intake and drain valves at various levels as well as pipes for reservoir drain discharge and water supply to the City of Pittsfield. At the ends of the dam are short earth embankment sections with concrete core walls.

The dam is in POOR condition. There are signs of concrete deterioration and longitudinal splitting of the top of the dam.

The preliminary hydrologic and hydraulic tests for this LARGE size dam with HIGH downstream hazards indicate that the spillway is adequate. The tributary area is mountainous but covered with a good stand of timber and is of very limited extent, only 0.46 square miles. This tributary area is augmented for water supply purposes by an aqueduct about 2 1/2 miles long to intercept an adjacent drainage area. The capacity of this aqueduct is small enough to prevent large flood flows from coming in by this route. The probable maximum flood on the tributary area plus the capacity of the aqueduct indicate a maximum probable inflow of about 1,450 cfs. When this inflow is routed through the reservoir, the test flood outflow would be about 850 cfs which does not exceed the capacity of the spillway. The capacity of the spillway above the fixed crest elevation (1585.0 MSL) to the top of the dam (1595.0 MSL) is 3000 cfs.

Failure of the dam will pose a serious threat to two houses and two water supply structures (the new screen house and the chlorinator building), as well as the access road to the dam including three crossings and a bridge and the roadway at October Mountain Road.

The recommendations and remedial measures recommended in Section 7 should be implemented within one year of the receipt of this report by

the Owner except for the recommendation for a stability analysis of the dam which should be implemented at once.

John W. Powers
Massachusetts Registration 23106

This Phase I Inspection Report on Farnham Reservoir Dam (MA-00314) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Frye

JOE B. FRIAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dam for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

Section			Page
LETTER OF TRANSMITTAL			
BRIEF ASSESSMENT			
REVIEW BOARD SIGNATURE SHEET			
PREFACE			i
TABLE OF CONTENTS			ii-iv
OVERVIEW PHOTO			v
LOCUS PLAN 1			vi
LOCUS PLAN 2			vii
REPORT			
1.	PROJECT INFORMATION		
	1.1	General	1-1
		a. Authority	1-1
		b. Purpose of Inspection	1-1
		c. Scope	1-1
	1.2	Description of Project	1-1
		a. Location	1-1
		b. Description of Dam and Appurtenances	1-2
		1) Concrete Dam	1-2
		2) Spillway	1-2
		3) Gatehouse	1-2
		4) Auxiliary Intakes	1-3
		c. Size Classification	1-3
		d. Hazard Classification	1-3
		e. Ownership	1-3
		f. Operator	1-3
		g. Purpose of Dam	1-4
		h. Design and Construction History	1-4
		i. Normal Operational Procedure	1-4
	1.3	Pertinent Data	1-4
2.	ENGINEERING DATA		
	2.1	Design Data	2-1
	2.2	Construction Data	2-1
	2.3	Operation Data	2-1
	2.4	Evaluation of Data	2-1

Section		Page
3.	VISUAL INSPECTION	
	3.1 Findings	3-1
	a. General	3-1
	b. Dam	3-1
	c. Appurtenant Structures	3-1
	d. Reservoir Area	3-2
	e. Downstream Channel	3-2
	3.2 Evaluation	3-2
4.	OPERATIONAL AND MAINTENANCE PROCEDURES	
	4.1 Operational Procedures	4-1
	4.2 Maintenance Procedures	4-1
	4.3 Evaluation	4-1
5.	EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES	
	5.1 General	5-1
	5.2 Design Data	5-1
	5.3 Experience Data	5-1
	5.4 Test Flood Analysis	5-1
	5.5 Dam Failure Analysis	5-2
6.	EVALUATION OF STRUCTURAL STABILITY	
	6.1 Visual Observation	6-1
	6.2 Design and Construction Data	6-1
	6.3 Post-Construction Changes	6-1
	6.4 Seismic Stability	6-1
7.	ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES	
	7.1 Dam Assessment	7-1
	a. Condition	7-1
	b. Adequacy of Information	7-1
	c. Urgency	7-1

Section		Page
7.	ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES (continued)	
	7.2 Recommendations	7-1
	7.3 Remedial Measures	7-2
	7.4 Alternatives	7-2

APPENDICIES

APPENDIX A - INSPECTION CHECKLIST

APPENDIX B - ENGINEERING DATA

APPENDIX C - PHOTOGRAPHS

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

SECTION 3 - VISUAL INSPECTION

3.1 Findings

(a) General

Farnham Reservoir Dam, No. MA 00314, was in FAIR condition at the time of the inspection.

(b) Dam (See photos in Appendix C)

The concrete dam was found to be covered with gunite on all exposed exterior surfaces. There were numerous cracks and areas where the gunite sounds hollow. On the upstream face at the left end above water level gunite had either not been applied or had broken off an area several feet long. Considerable efflorescence was observed at cracks in the gunite especially on the spillway discharge channel walls. Expansion joints on the downstream face have been sealed with a white plastic sealer. The top of the dam has been covered with gunite or cement mortar in sections about 20 feet long and the joints sealed with asphalt sealer. In several places the concrete topping has cracked and heaved upward as much as 1¼ inches.

Several inspection wells were observed to have considerable efflorescence. Hardware in the inspection wells was in excellent condition with only light rust covering stair rungs and guardrail. There was little seepage into the inspection wells and only a little water at the bottom of the shafts. Concrete at the center of blocks seemed to be sound, but at joints it tended to be soft and in same cases a pickhammer would penetrate up to an inch. Expansion joints in the inspection wells showed spalling up to 2 inches back from the joint and about 1/2 inch deep. Cracking was observed in the inspection wells, that was up to 1/4 inch wide at the top and extending down to the gallery landing and aligned along the long axis of the dam.

The gate house was found in poor condition. The walls above window sill height have tipped out about 1/4 inch on all sides and cracked above the window lintels. The gate house floor appeared to be in good condition as were the gate operating hand wheels which were secured from unauthorized operation by a steel cable and lock.

(c) Appurtenant Structures

The earth embankment against the downstream face of the dam is in good condition and stable though no surface protection was provided beyond a sandy gravel surface. The earth embankments on each side of the concrete section are in good condition and no seepage, cracking or signs of distress were observed.

(c) Validity

Since the observations of the inspection team generally confirm the available data, a satisfactory evaluation for validity is indicated.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

Design data other than that appearing on the plans that were furnished by the Pittsfield Engineering Department were not available for review. Review of the data available indicated design to be consistent with good engineering practice.

2.2 Construction Data

No detailed construction information was available. The design plans available for this dam show good agreement with the visual inspection.

2.3 Operational Data

Farnham Dam is normally operated at full or nearly full reservoir levels for water supply purposes.

Reservoir level is checked by operator visit to site to observe the level at the face of dam. Any unusual conditions are noted and corrective action taken. The summer reservoir level is maintained at about 1587 MSL or 2 feet above spillway (elevation 1585 MSL) by the installation of stop logs. The winter reservoir is maintained at about elevation 1584.1 MSL. Reservoir level is varied between these elevations in accordance with demand and allocations of drafts from various city reservoirs.

During storms and peak runoff periods the 24 inch intake conduit from Clapp Pond is closed and the flow is wasted to Roaring Brook waterway. No other storm control measures are practiced.

A 24 inch outlet from the gate well flows directly to the chlorinator and the City of Pittsfield. Flow is controlled by demand and downstream gates.

2.4 Evaluation of Data

(a) Availability

Data on the original size and form of facilities are available at the Pittsfield Engineering Department. Data on recent modifications and repairs are available at Metcalf and Eddy, Inc., Boston, Mass. Data on State inspections are available at the Massachusetts Division of Waterways (see Appendix B).

(b) Adequacy

The data available is adequate to permit an evaluation of the size and form of the facilities when combined with visual inspection observations and engineering experience and judgement. The data available is not adequate to fully evaluate the safety of the Farnham Reservoir Dam.

4. Gates: 12 inch diameter manual vertical lift drain sluice gate.
24 inch diameter manual vertical lift water supply sluice gate.
Stop logs: 4 bays 6'-4" clear opening by 10.0' feet high

5. Upstream channel: Reservoir

6. Downstream channel: Gunite surfaced concrete spillway chute.
Concrete training walls
Concrete surfaced, stone paved concrete floor.

(j) Regulating Outlets

1. Flashboards regulate pond elevation

a. Bottom elev. 1,584.5 feet MSL

b. Size: Length: 4 bays of 6'-0"=24.0 feet total
Height: up to 10 feet

c. Description: Steel channels provide for 4 1/4 inch thick stop logs. Steel channels are anchored in the spillway crest and attached to the upstream face of the spillway bridge.

d. Control mechanism: Flashboards or stop logs are placed in the slots across each spillway opening manually as desired. Removal is also manual

2. Reservoir drain:

a. Inlet Invert: elevation 1499.5 feet M.S.L.
Outlet Invert: elevation 1489 feet M.S.L.

b. Size: 12 inch diameter

c. Description: Cast iron pipe 58± feet long

d. Control mechanism: Hand operated sluice gate with hand wheel and lift stand on gate house floor at top of dam.

3. Spillway crest pool (1,585.0 ft. MSL): 42.3

4. Test flood pool (1,589 ft. MSL): 44.2

5. Top of dam (1,595.0 ft. MSL): 46.9

(g) Dam

1. Type: Gravity, Cyclopean concrete

2. Length: 750± ft.

3. Height: 105 ft.

4. Top width: 14.50 ft.

5. Side slopes: Upstream: Verticle
downstream: 0.644:1

6. Zoning: Cyclopean concrete main dam
Reinforced concrete spillway crest
Earth embankment ends
Concrete core wall in earth embankment ends

7. Impervious core: (in earth embankment ends)
Concrete, 2.50 feet wide top;
Downstream batter = 1:4±
Upstream batter = 1:7±

8. Cutoff: Cyclopean concrete in trench in rock at least 6 ft. x 6 ft.

9. Grout curtain: None

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillway

1. Type: Ogee, reinforced concrete

2. Length of weir: 24 feet effective length

3. Crest elevation:

1. No flashboard: elev. 1585.0 feet MSL

2. Max. flashboard or stop log: elev. 1595.0 feet MSL

(c) Elevation (feet above MSL)

1) Streambed at tow of dam: 1490

2) Bottom of cutoff: 1488±

3) Maximum tailwater: Unknown

4) Normal pool: 1,585.0

5) Full flood control pool: Not applicable

6) Spillway crest:

a) Fixed concrete spillway: 1,585.0

b) Pond drain inlet: 1,512.0

7) Design surcharge: Unknown

8) Top of dam: 1,595.0

9) Test flood surcharge: 1589.3

(d) Reservoir (Length in feet)

1. Normal pool (1,585.0 ft. MS.): 2,150

2. Flood control pool: Not applicable

3. Spillway crest pool (1,585.0 ft. MSL): 2,150

4. Top of Dam (1,1595.0 ft. MSL): 2,250

5. Test flood surcharge (1,589 ft. MSL): 2,200

(e) Storage (acre-feet)

1. Normal pool (1,585.0 ft. MSL): 1455

2. Flood control pool: Not applicable

3. Spillway crest pool (1,585.0 ft. MSL): 1455

4. Top of dam (1,595.0 ft. MSL): 1900

5. Test flood pool (1,589 ft. MSL): 1646

(f) Reservoir Surface (acres)

1. Normal pool (1,585.0 ft. MSL): 42.3

2. Flood control pool: Not applicable

2) Maximum Known Flood

The maximum reservoir level is reported to have been about elevation 1589.5 feet M.S.L., or 5.5 feet below top of dam. The date and stop log condition at the time is unknown, so no estimate of discharge can be made.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the spillway above the fixed crest elevation (1,585.0 feet M.S.L.) to the top of the dam (1,595.0 feet M.S.L.) is 3000 cfs.

4) Ungated Spillway Capacity at Test Flood

The capacity of the ungated spillway with the reservoir at test flood elevation (1,589.3 feet M.S.L.) is 850 cfs.

5) Gated Spillway Capacity at Normal Pool

The capacity of the 12 inch drain at normal pool elevation (1,585.0 feet M.S.L.) is 35 cfs. The capacity of the 24 inch water supply outlet is 105 cfs.

6) Gated Spillway Capacity at Test Flood

The 12 inch drain capacity at test flood elevation (1,589.3 feet M.S.L.) is 35 cfs. The capacity of the 24 inch water supply outlet is 107 cfs.

7) Total Spillway Capacity at Test Flood

The total capacity of spillway, 12 inch drain, and 24" water supply at test flood elevation (1589.3 feet M.S.L.) is 990 cfs.

8) Total Project Discharge at Top of Dam

Total project discharge including spillway, 12 inch drain and 24 inch water supply outlet being wasted with reservoir at top of dam (elevation 1595.0 feet M.S.L.) is 3145 cfs.

9) Total Project Discharge at Test Flood

Total project discharge with no flashboards above spillway fixed crest elevation (1,585.0 feet M.S.L.), and including 12 inch drain and 24 inch water supply outlet being wasted and reservoir at Test Flood elevation (1589.3 feet M.S.L.) is 990 cfs.

1.3 Pertinent Data

(a) Drainage Area

The direct drainage area of this dam covers about 0.46 square miles or about 296 acres. The terrain is mountainous rising over 400 feet within one half mile of the reservoir. The area has good forest cover.

An adjacent drainage area tributary to Clapp Pond which lies about 1 1/2 miles southeast of Farnham Reservoir is brought to this reservoir via open channels and a 24 inch diameter conduit having a capacity of about 23 cfs. (See drainage area map in Appendix D)

(b) Discharge at Dam Site

1. Outlet Works

Normal discharge at the site is via a 24 inch pipe outlet from the gate well to the City of Pittsfield water distribution system with excess going over the spillway. There is also a 12 inch reservoir drain pipe.

The spillway crest is a reinforced concrete ogee type with crest at elevation 1585.0 feet M.S.L., N.G.V.D. The crest is fitted to allow stoplog or flashboard installation to the top of the dam at elevation 1595.0 feet M.S.L. Although the stop log guides og to the top of the dam, visual evidence indicates stop logs have been installed only to a maximum height of 2 feet. The spillway side walls rise to the elevation of the top of the concrete dam at elevation 1595.0 feet M.S.L. A concrete arch bridge over the spillway downstream of the spillway crest will not affect spillway capacity because drawdown to the crest will be below the bridge.

The 24 inch water supply outlet runs from a 24 inch sluice gate in the gate well at about elevation 1500.00 feet M.S.L., N.G.V.D.; through the dam and under the spillway discharge channel to a new screenhouse now under construction and then on to the Pittsfield water distribution system. There are provisions in the screenhouse to divert water to the brook below the dam.

There is a 12 inch cast iron pipe inlet and gate valve at elevation 1508 feet M.S.L., N.G.V.D. in the gate well that provides reservoir drain via an intake basin out in the reservoir with top at about elevation 1512 feet M.S.L. A 12 inch sluice gate controlled pipe at about elevation 1500 feet M.S.L. in the gate well allows water drainage into the spillway discharge channel at about elevation 1490 feet M.S.L.

(f) Operator

The Farnham Reservoir Dam is operated by the City of Pittsfield through its Water Department. The Superintendent of the Water Department is Mr. Alfonso Yovis, who can be reached by telephone at (413) 443-6112. The night number is (413) 442-0921.

(g) Purpose

The purpose of Farnham Reservoir Dam is to provide a water supply reservoir and intake for the City of Pittsfield, Massachusetts.

(h) Design and Construction History

Based on available plans, the dam was designed by Arthur B. Farnham about 1900.

Construction history is unknown except that it was completed by 1910.

In 1950 considerable rehabilitation work was carried out on the upstream face of the dam above elevation 1555 M.S.L. (the upper 40 feet of the dam).

About 1976 or 1977 the downstream face of the dam was repaired and resurfaced.

(i) Normal Operating Procedure

Farnham Dam is normally operated at full or nearly full reservoir levels for water supply purposes.

Reservoir level is checked by operator visit to the site about three times each week to observe the water level at the face of the dam. Any unusual conditions are noted and corrective action taken. During the summer the reservoir is normally maintained at a level about two (2) feet above spillway crest with stop logs. During the winter the reservoir is normally maintained at a level below the flashboards, about ten (10) inches below spillway crest. Reservoir level varies from these norms due to demand and allocations of drafts from various city reservoirs.

During storms and peak runoff periods the 24 inch intake conduit from Clapp Pond is closed and the flow is wasted to Roaring Brook. No other storm control measures are practiced.

The 24 inch outlet from the gate well flows directly to the screenhouse and the City of Pittsfield. Flow is controlled by demand and downstream gates.

Inlet pipes with gate valves are provided at the following elevations:

1570 ft. M.S.L.	20 in. pipe
1545 ft. M.S.L.	20 in. pipe
1525 ft. M.S.L.	24 in. pipe
1508 ft. M.S.L.	12 in. pipe

The lowest pipe, 12 inch diameter, connects to a reservoir drain well out in the reservoir about 100 feet from the gate well. The drain well top is at elevation 1512.0 M.S.L.

There are two outlet pipes at the bottom of the gate well. The inlets are controlled with round sluice gates of full pipe diameter. There is a 12 inch pipe acting as a drain that runs through the dam and discharges in the corner of the spillway discharge channel. Also, there is a 24 inch pipe that extends thru the dam and runs under the discharge channel to a chlorination building and the transmission pipeline to the City of Pittsfield.

4) Auxiliary Intake

To supplement the runoff from the small drainage area tributary to Farnham Reservoir an aqueduct has been constructed from the divide about 2 miles south of Farnham Reservoir to intercept the drainage east of Clapp Pond. The aqueduct consists of an open ditch and a 24 inch diameter conduit. A control house with control gate valves to control flow to Farnham Reservoir and overflow to Roaring Brook has been built to regulate flow from this source.

(c) Size Classification

The dam's maximum impoundment (computed at the top of the dam) of about 1900 acre feet and height of 105 feet place it in the LARGE size classification.

(d) Hazard Classification

The hazard classification for this dam is HIGH because of the potential for loss of human life and property which may occur in the event of a dam failure. There is a high potential for severely damaging two houses and two water supply buildings with attendant probable loss of more than a few lives as well as the destruction of the access road to the dam including three crossings of Mill Brook on the access road and the loss of a section of October Mountain Road and the roadway bridge.

(e) Ownership

The Farnham Reservoir Dam is owned by the City of Pittsfield represented by its Board of Water Commissioners. Their offices are at City Hall, 70 Allen Street, Pittsfield, Massachusetts 01201.

by taking New Lenox Road at a point about 3.6 miles south of the center of Pittsfield. New Lenox Road is followed east about 1.8 miles to October Mountain Road; then continue east up the Mill Brook valley about two miles to Farnham Dam. The dam is shown on U.S.G.S. topographic quadrangle at latitude N 42°23'28" and longitude W 73°12'19". See Locus Plan, Page vi.

(b) Description of Dam and Appurtenances

Farnham Reservoir Dam is a concrete gravity structure 105 feet high from deepest foundation to top of dam. The dam is 750 feet long with an ogee spillway and chute near the center. There is an intake and gate well adjacent to the spillway.

1) Concrete Dam

The dam is built of cyclopean concrete with vertical expansion joints at 80 foot intervals and a cutoff or anchor trench of at least 6 feet x 6 feet in good rock. There is an inspection well at each expansion joint. The expansion joints are keyed by offsetting concrete blocks about two feet and sealed with copper strips. The bottoms of the inspection wells are connected with 8 inch cast iron pipe that drains to the spillway discharge channel. Selected earth material was placed and rolled in 4 inch layers against the lower 10 to 35 feet of both upstream and downstream faces of the dam. The concrete gravity center part of the dam is abutted by earth embankments (150 feet long on the right and 80 feet long on the left) which are up to 25 feet high and at least 52 feet wide on top. The earth abutment sections are 2.5 feet higher than the top of the concrete section and a concrete core wall 2.5 feet thick at the top was built in the center of the earth sections. All exposed surfaces of the concrete dam and spillway have been covered with gunite mortar.

2) Spillway

The spillway is 25 feet long with an ogee crest of 7.5 feet radius. The crest is reinforced with 1 1/4 inch steel rods both ways extend down 25 feet into the dam on 18 in. cc. Training walls guide the overflow down the face of the dam. The spillway chute rounds out at the bottom to deliver overflow into a discharge channel that is 20 feet wide at the end where it discharges into the downstream brook.

3) Gatehouse

A concrete gatehouse with a top floor at top of dam elevation measuring 10 ft. x 12 ft. inside stands next to the right side of the spillway. A gate well measuring 10 ft. x 10 ft. extends in front of the upstream face of the dam from the top of the dam at elevation 1595 feet M.S.L., N.G.V.D. to a bottom at elevation 1500.5 feet M.S.L., N.G.V.D.

PHASE I INSPECTION REPORT

FARNHAM DAM

SECTION 1

PROJECT INFORMATION

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Tighe & Bond/SCI (T&B) has been retained by the New England Division to inspect and report on selected dams in Massachusetts. Authorization and notice to proceed were issued to Tighe & Bond/SCI under a letter of October 24, 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW 33-80-C-0005 has been assigned by the Corps of Engineers for this work.

(b) Purpose

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickely, effective dam safety programs for non-federal dams.

3) Update, verify, and complete the National Inventory of Dams.

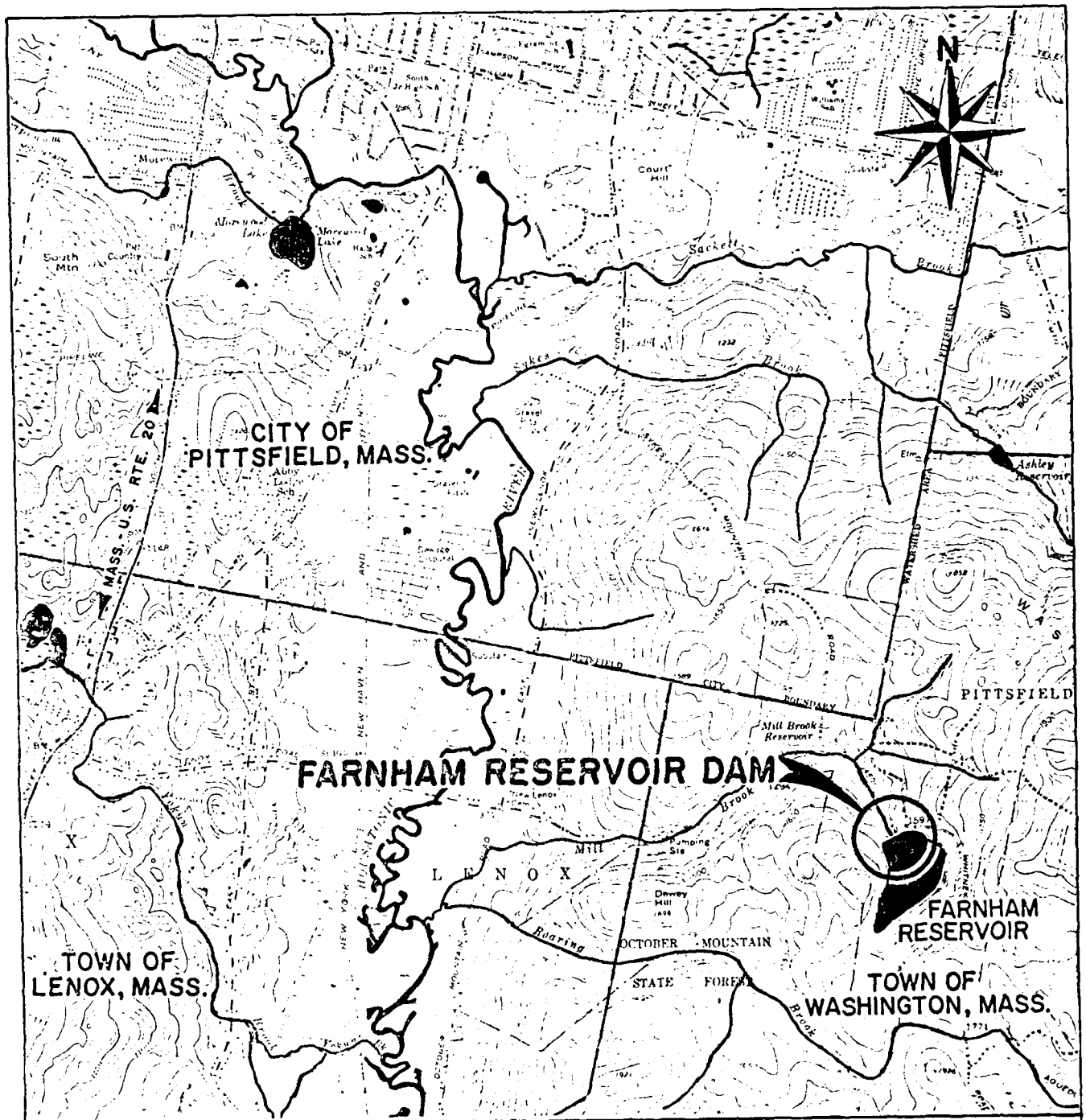
(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams, and those dams in the significant hazard potential category believed to represent an immediate danager based on condition of the dams.

1.2 Description of Project

(a) Location

Farnham Reservoir Dam is located in the Town of Washington on Mill Brook about two (2) miles east of its confluence with the Housatonic River just south of the Pittsfield - Lenox town line near New Lenox. The dam can be reached from U. S. Route 20



-SCALE-

1000' 0 1000' 2000' 3000' 4000' 5000'

FROM: U.S.G.S. PITTSFIELD WEST, & PITTSFIELD EAST, MASS. QUADRANGLE MAPS

QUADRANGLE LOCATION

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

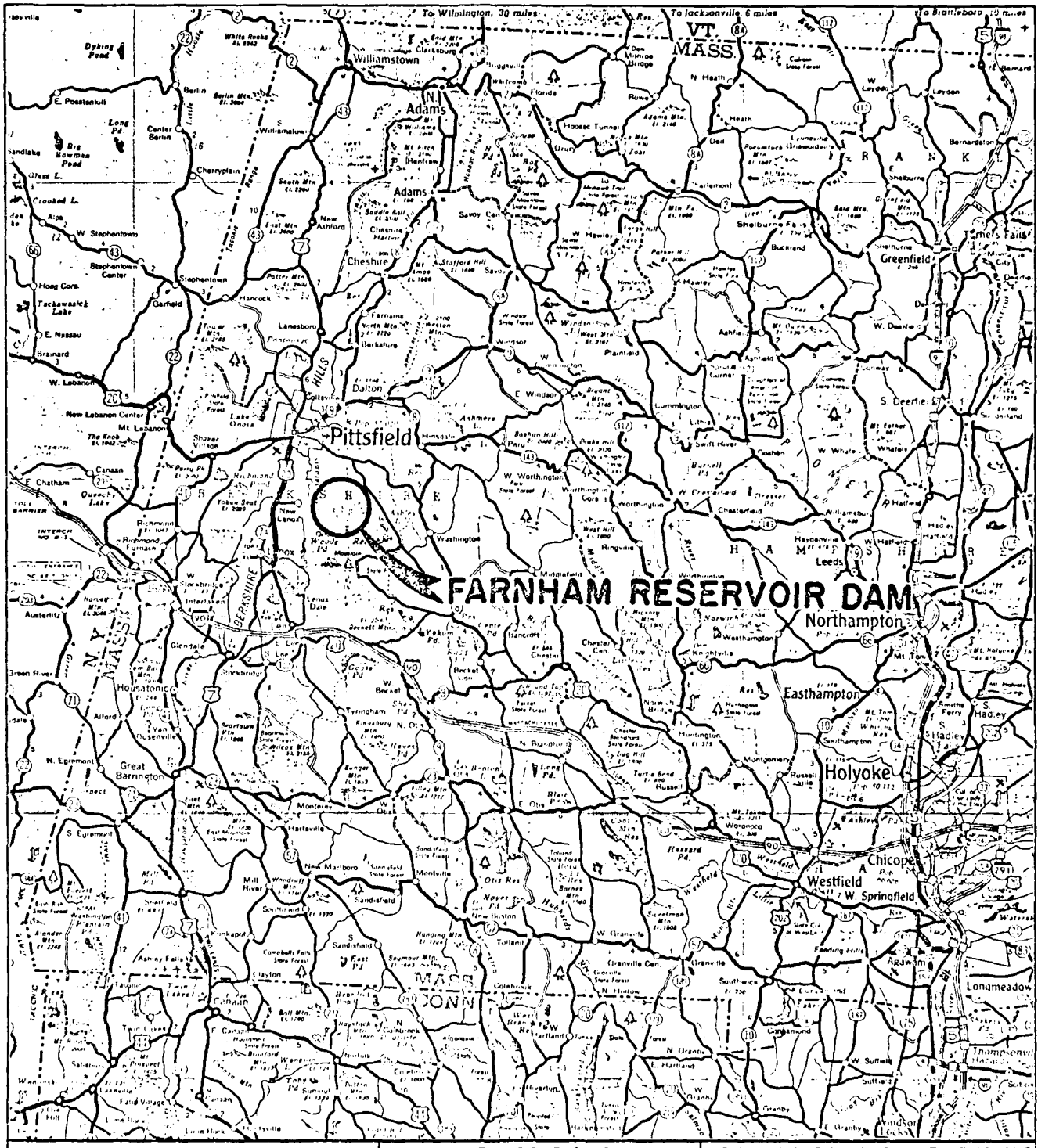
LOCUS PLAN 2

FARNHAM RESERVOIR DAM (MA00314)
BERKSHIRE COUNTY

WASHINGTON
MASSACHUSETTS

SCALE: AS NOTED

DATE: FEBRUARY 1980



TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

5 0 5 10
SCALE IN MILES

MAP LOCATION

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN 1

FARNHAM RESERVOIR DAM (MA00314)
BERKSHIRE COUNTY

WASHINGTON
MASSACHUSETTS

SCALE: AS NOTED

DATE: FEBRUARY 1980

The spillway chute has been repaired with gunite and weep holes provided thru the gunite of the chute floor. The spillway chute floor repair appears to be in good condition. The spillway training walls have many cracks in the gunite surface. Along the discharge channel walls the gunite has deteriorated considerably. There is considerable cracking, stain and efflorescence. The concrete floor reconstruction of the spillway discharge channel has broken up and much has washed away. In some areas there is water flowing or seeping into the channel at the base of the wall.

(d) Reservior Area

The reservoir area and shore appeared to be in good condition, clear and free of any debris.

(e) Downstream Channel

The brook channel downstream of the dam is a natural, steep brook bed lined with boulders. The boulders are typically about five (5) feet maximum dimension.

3.2 Evaluation

The dam is generally in FAIR condition. There is evidence of loss of strength of the concrete along some block margins where a geologists rock pick can be stuck into the concrete and as indicated by patches of loose gunite. Sealing of the expansion joints in the downstream face is not considered desirable as it may trap water in the joint. There does not appear to be significant leakage into the inspection wells or inspection well drain - assuming it is open and functioning properly.

The following deficiencies or problems were noted:

1. Cracks at the top of inspection wells indicate cracking along the long axis of the top of the dam.

2. Cracks, efflorescence and hollow sounds indicate loose and deteriorating gunite coating and/or concrete base.

3. Inspection well drains may be plugged or partially plugged as indicated by the little water flow observed at the inspection drain outlets in the spillway.

4. There are indications of deteriorating or inadequate concrete strength.

5. Sealing the expansion joints in the downstream face of the dam may trap water and lead to deterioration.

6. The mortar topping on the dam top is heaving and cracking in some areas.

7. The spillway discharge channel has loose concrete and stained sidewalls with considerable efflorescence.

SECTION 4 - OPERATION AND MAINTENANCE PROCEEDURES

4.1 Operational Procedures

Farnham Reservoir Dam is normally operated at full or nearly full reservoir levels for water supply purposes.

Reservoir level is checked by operator visit to the site about three times each week and observing the level at the face of dam. Any unusual conditions are noted and corrective action taken. During the summer the reservoir is normally maintained at a level about two (2) feet above spillway crest with stop logs. During the winter the reservoir is normally maintained at a level about ten (10) inches below spillway crest. Reservoir level varies from these norms due to demand and allocations of drafts from various city reservoirs.

During storms and peak runoff periods the 24 inch intake conduit from Clapp Pond is shut off and the flow is wasted to Roaring Brook. No other storm control measures are practiced.

The 24 inch outlet from the gate well flows directly to the new screenhouse and the City of Pittsfield. Flow is controlled by demand and downstream valves.

4.2 Maintenance Proceedures

Minor maintenance is taken care of as needed. Existance of a regular inspection and maintenance schedule is unknown. The Massachusetts Division of Waterways has inspected the dam periodically.

4.3 Evaluation

More detailed operating procedures for normal conditions are not considered necessary. A formal, written emergency downstream flood warning system should be developed and put into operation. Further operating procedures for flood situations should be considered and flashboard elevations determined to assure safety.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Farnham Reservoir Dam is located on Mill Brook about 10,000 feet above October Mountain Road in the Town of Washington, Massachusetts. This site is about 12,000 feet from the confluence of Mill Brook with the Housatonic River in Lenox, Massachusetts. The drainage area of about 0.46 square miles, about 296 acres, is located in mountainous terrain that rises about 400 feet within 2000 feet of the reservoir. The site is near the western edge of the Berkshire upland east of the Housatonic River flood plain. Bedrock in this area is generally mica schist covered with glacial deposits of great variety. This steep watershed is covered with a good stand of forest.

The spillway of the dam is a concrete ogee crest and chute down the face of the gravity concrete dam to a short curved discharge channel and the rocky brook.

Downstream of the dam site, Mill Brook runs for nearly two miles down a steep, narrow, rocky, wooded ravine and across a narrow outwash fan, that is partly cultivated, to October Mountain Road and the Housatonic River flood plain, which is extensively cultivated.

5.2 Design Data

Hydraulic and hydrologic design data is not available.

5.3 Experience Data

Selected data for locations in the same area as Farnham Dam indicates that a record maximum of 200 cfs infow to Farnham Dam may have been likely in August 1955. See Appendix D.

5.4 Test Flood Analysis

The objective of the test flood analysis is to assess the capacity of the dam to safely pass a severe runoff event of a size commensurate with the size of the dam and the downstream hazard to life and property.

Guidelines for establishing a test flood are specified in "Recommended Guidelines" of the Corps of Engineers. The height of this dam (105 feet), puts it in the LARGE class though the storage volume at the top of the dam, of 1900 ac. ft. indicates intermediate size. The potential, resulting from dam failure, for significant damage to one local road, as well as the access road to the dam and two houses and two water supply structures with the possible loss of more than a few lives, puts this project in the HIGH hazard category. Table 3 of the Corps of Engineers "Recommended Guidelines" indicates that the spillway test flood for a LARGE size, HIGH hazard dam should be PMF. The spillway test flood applied was the full PROBABLE MAXIMUM FLOOD.

Storm runoff of a maximum probable flood was estimated based on U.S. Corps of Engineers, New England Division "Preliminary Guidance for Estimating Maximum Probable Discharges". A discharge of 3080 cfs. per sq. mile for this drainage basin of 0.46 sq. miles gives an inflow to Farnham Reservoir of 1425 cfs. To this was added the capacity (23 cfs) of the 24 inch diameter pipe carrying diversion in from the Clapp Pond watershed. This gave a total spillway test flood of about 1450 cfs. When this test flood is routed through the reservoir, the resultant outflow is about 850 cfs.

The spillway is able to pass this flood flow with a maximum head of about 4.2 feet with freeboard of about 5.8 feet.

It is recognized that stoplogs could be installed on the spillway crest that might not fail and could result in overtopping the dam. Although observation indicates that a maximum of two feet of stop log height is installed, installation of larger stop log heights can only be guarded against by limiting the height of the stop log guides.

Analysis of large storm runoff peaks in the area indicates that about 200 cfs was probably the maximum flood inflow to date. The reported minimum freeboard of 5.5 feet also indicates that this spillway is adequate.

5.5 Dam Failure Analysis

The hazards and potential damages resulting from failure of Farnham Reservoir Dam were evaluated assuming reservoir level at spillway test flood level (elev. 1590 feet MSL) by the procedures suggested in New England Division, Corps of Engineers "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." No allowance was made for possible clogging of waterways caused by trees and debris. The length of the dam at mid height and the height of the dam were taken from the plans of the dam provided by the Pittsfield Engineering Department. The length was taken at elevation 1545 MSL to the assumed line of ledge shown on the plans. This gave a length of 380 feet. The peak discharge using the suggested "Rule of Thumb" is 236,640 cfs. This flow was routed downstream to the Housatonic River.

The estimated peak discharge resulting from the sudden failure of Farnham Reservoir Dam is large enough to destroy everything within forty (40) feet of the bottom of the valley. This will include the new screenhouse, the old Amberson dam at the former Mill Brook Reservoir which has been breached, the chlorinator house, and all roads and bridges within reach of the rush of water.

At October Mountain Road the dam failure flood will flow over the road nine (9) feet deep. This would destroy the two houses near Mill Brook.

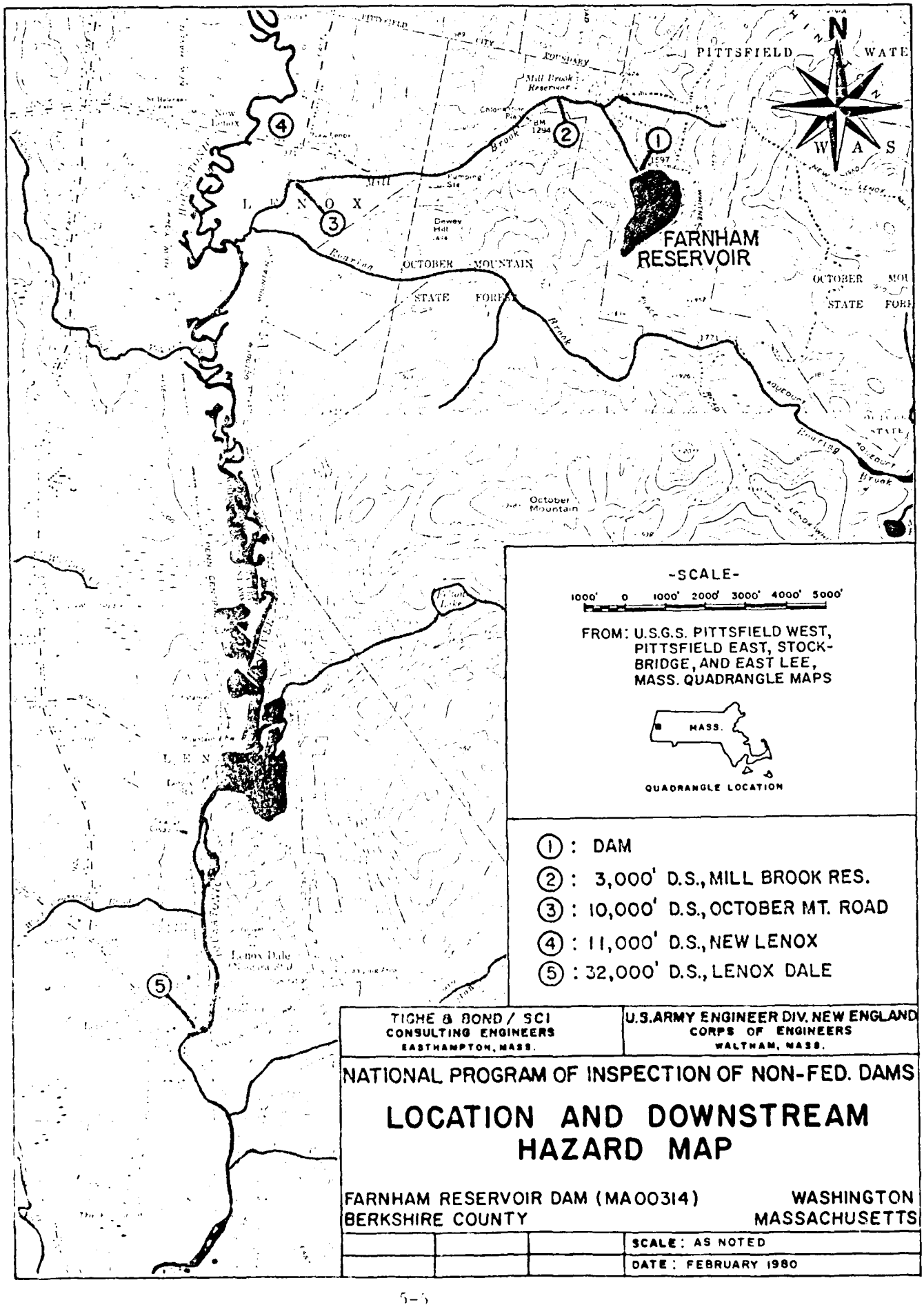
A flood flow before dam failure of 850 cfs which is equal to the maximum probable spillway discharge was analyzed flowing down the valley. This flow will cause no serious damage in this steep mountain stream.

At Lenox Station and Lenox Dale the maximum attenuated flow would probably not exceed 6000 cfs due to storage volume on the flood plain and the control effects of the restricted width of the river at Lenox Station.

The wave of water from the failure of the Farnham Reservoir Dam would probably amount to a depth of about 1.4 feet on the flood plain between New Lenox Road and Lenox Station. This flood would not endanger any structures or lives.

DOWNSTREAM IMPACTS OF DAM FAILURE

Map Location No.	From Dam Feet	Feature	No. of dwellings (Buildings)	Before Dam Failure: Flood Stage cfs-ft.	Before Dam Failure: Depth Over Rd. Ft.	Before Dam Failure: Buildings Damaged	After Dam Failure: Flood Stage cfs.-ft.	After Dam Failure: Depth Over Road feet	After Dam Failure: Buildings Damaged	Comments
1.	0	Dam	1	850 3	---	0	236,640 37	17	1	Screenhouse damaged.
2.	3000	Mill Brook Reservoir Breached	--	850 3	---	--	200,000 34	4	--	Breached dam would collapse; road & bridges destroyed; chlorinator house damaged
3.	10,000	October Mt. Road	2	850 3	0	0	133,000 18	9	2	Road & 2 houses destroyed. by failure
4.	11,000	New Lenox	35	1170 4	0	0	6000 9 960 MSL	0	0	Dam failure stored on flood plain
5.	32,000	Lenox Dale	70	1170 3	0	0	6,000 9	0	0	



-SCALE-

1000' 0 1000' 2000' 3000' 4000' 5000'

FROM: U.S.G.S. PITTSFIELD WEST, PITTSFIELD EAST, STOCKBRIDGE, AND EAST LEE, MASS. QUADRANGLE MAPS

QUADRANGLE LOCATION

① : DAM
② : 3,000' D.S., MILL BROOK RES.
③ : 10,000' D.S., OCTOBER MT. ROAD
④ : 11,000' D.S., NEW LENOX
⑤ : 32,000' D.S., LENOX DALE

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NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

FARNHAM RESERVOIR DAM (MA00314) WASHINGTON
BERKSHIRE COUNTY MASSACHUSETTS

SCALE: AS NOTED
DATE: FEBRUARY 1980

SECTION 6 - EVALUATION OF STRUCTURE STABILITY

6.1 Visual Observation

Visual inspection of Farnham Reservoir Dam revealed evidence of a longitudinal split in the top of the dam opening upward from about ten (10) feet below the top of dam to a width of about 3/8 inch at the top. There was also evidence of deterioration of concrete strength, e pecially at the margins of concrete blocks. Cracks in the gunite facing, efflorescence, and hollow sounds made by tapping with a hammer also indicate possible deterioration.

6.2 Design and Construction Data

Available design and construction data provided information on dimensions and arrangement of the facilities. Design data regarding strength and stability are not available for review. No construction data or notes were available for review. Without information on concrete strength and condition, no meaningful evaluation of structural adequacy can be made.

6.3 Post Construction Changes

The plans indicate that in 1950 the upstream face of the dam was reconditioned above elevation 1555 feet MSL - the upper 40 feet of the dam.

It is reported that the guniting of the entire downstream face was carried out within the last five years.

Comparing the spillway and outlet works to the plans indicates several changes since construction. The gate well release pool has been filled in. The 12 inch drain pipe has been extended through the spillway discharge channel wall to discharge directly into the discharge channel. The 24 inch discharge pipe has been extended under the spillway discharge channel to the screenhouse and transmission pipeline to the City of Pittsfield.

The Massachusetts Division of Waterways' most recent inspection report, May 23, 1978, reported the dam to be in good condition with extensive work done on the structure.

6.4 Seismic Stability

Farnham Reservoir Dam is located in seismic zone No. 2. According to the recommended Corps of Engineers guidelines, a seismic analysis is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The dam is generally in POOR condition. There are signs of deterioration of concrete and structure splitting near the top.

(b) Adequacy of Information

There is insufficient design and constructon data available to permit modern stability analysis comparable to the requirements of paragraph 4.4 of the "Recommended Guidelines for Safety Inspection of Dams."

(c) Urgency

The recommendations and remedial measures described herein should be implemented within one year of receipt of this Phase I Inspection Report, except for the recommendation for a stability analysis of the dam which should be implemented at once.

7.2 Recommendations

It is recommended that the following studies be conducted under the supervision of a qualified, registered professional engineer.:

1. A stability analysis of the dam should be carried out. The following items should be considered as part of this analysis:

   a) Consideration should be given to the installation of strain and movement gauges concurrent with, or as a result of, the stability analysis.

   b) The apparent deterioration of concrete should be investigated as part of the stability analysis.

   c) The longitudinal cracking in the top of the dam should be investigated as part of the stability analysis.

   d) Gunite and topping deterioration, cracking, and looseness and the extent and seriousness of these conditions should be investigated.

   e) The sealing of the expansion joints on the downstream face of the dam should be evaluated.

2. Investigate the feasibility of cutting off the steel channel stop log guides to limit the maximum possible stop log height.

3. Investigate the discharge channel physical condition and the need for corrective measures, if any.

7.3 Remedial Measures

The following remedial, maintenance and operation procedures are recommended:

1. Develop and implement a formal, written downstream emergency flood warning system.

2. Develop and implement a program of complete annual technical inspections supplemented by regular reports of operating conditions and changes.

3. Confirm that inspection well drains are open, operating properly and that seepage is not excessive.

7.4 Alternatives

There are no practical alternatives to the above recommendations except as follows:

Recommendation 7.2(2) could be replaced with a program of daily operating checks and sufficient procedures, equipment and staff on continuous alert at all hours to remove stop logs. This would not be as effective or reliable as the recommended measure.

APPENDIX A

INSPECTION CHECKLIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Farnham Dam

DATE 11/7/79

TIME

WEATHER Overcast

W.S. ELEV. U.S. DN.S.

PARTY: Tighe & Bond/SCI

1. John W. Powers, Project Manager
2. George H. McDonnell, Hydrology/Hydraulics
3. David M. Lenart, Civil
4. Howard A. Koski, Civil
5. Edward A. Moe, Soils/Hydraulics
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	All project features were inspected by all party members		
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Also present:

R. Pulver - City of Pittsfield Water Department

INSPECTION CHECK LIST

PROJECT Farnham Dam — DATE 11/7/79

PROJECT FEATURE Concrete Dam — NAME Tighe & Bond Party

DISCIPLINE — NAME

AREA EVALUATED	CONDITIONS
DAM ~~EMBANKMENT~~	
Crest Elevation of Top of Dam	1595.1
Current Pool Elevation	1586.9
Maximum Impoundment to Date	1589.5
Surface Cracks	Some in gunite, mostly minor. Gunite at copping edge is generally cracked. Gunite sounds hollow in many areas.
Pavement Condition	Fair, center crowned to drain. Joints sealed asphalt. Some heaves areas.
Movement or Settlement of Crest	None
Lateral Movement	Verticle crack along axis of dam shows in inspection galleries: ½" at top to 1/16", landing 10' down
Vertical Alignment	Fair; heaves of up to 1½"
Horizontal Alignment	Good. Minor movement & spawling along expansion joints seen in inspection galleries
Condition at Abutment and at Concrete Structures	Good, except gunit face break 6"x2' long above waterline on upstream face left end. Some concrete softening at block-joi
Indications of Movement of Structural Items on Slopes	Crack in inspection galleries indicate longitudinal split opening at top and extending down about 10'
Trespassing on Slopes	Not applicable
Vegitation on Slopes	Not applicable
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	Not applicable. Earth bank against toe is in good condition.
Unusual Movement or Cracking at or near Toes	Expansion joints are sealed with white compound on downstream face.
Unusual Embankment or Downstream Seepage	None. Some water in inspection well bottoms. Only minor leakage into inspection wells. 94.5' top of dam to water at bottom of well No. 3
Piping or Boils	None
Foundation Drainage Features	Foundation & gallery drains appear to be functioning. Minor drainage observed.
Toe Drains	Appear to be in place & functioning. None or only minor drainage seen.
Instrumentation System	Stake marks painted on upstream face.

INSPECTION CHECK LIST -

PROJECT Farnham Dam

DATE 11/7/79

PROJECT FEATURE Spillway crest stop logs
Inlet diversion conduit

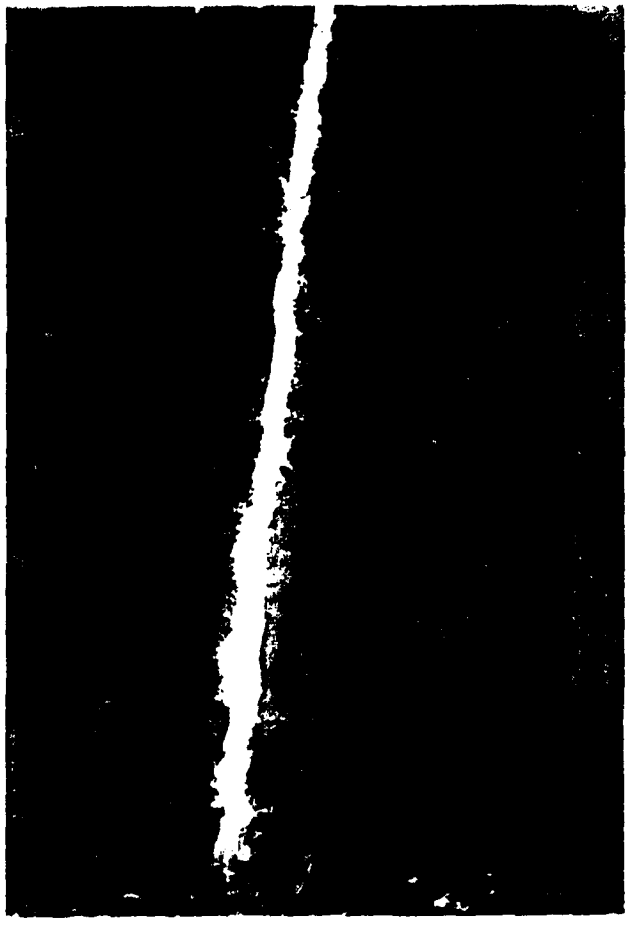
NAME Tighe & Bond Party

DISCIPLINE

NAME

AREA EVALUATED	CONDITION
~~OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE~~	
a. Approach Channel	24" V.C. pipe brings diverted Clapp Pond watershed into Farnham Reservoir. Control house to stop inflow and waste conduite flow to other drainage brook. Flow observed: 6"± deep, 5± fps
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
~~Trash or Weir Racks~~	
b. ~~Intake Structure~~ Spillway Crest Stop Logs	
Condition of Concrete	Gunited, Good
Stop Logs and Slots	Spillway approach bay is 26.50 ft. wide. Guides are builtup of steel plate and 4 angles set into spillway crest apron and fastened to upstream face of spillway bridge. General rust on mild steel as normal. Slots have 4½" clear space for logs. 4 stop logs at 6'-0" = 24'-0" clear Dam top down to top of stop logs: 8.3', 7.9', 7.9',

nd of typical expan-
joint sealing on
treem face of dam,
of spillway.



ad of typical
sion joint seal on
stream face of dam
of spillway.

Photo 6

Downstream face of dam, right end view from spillway end.

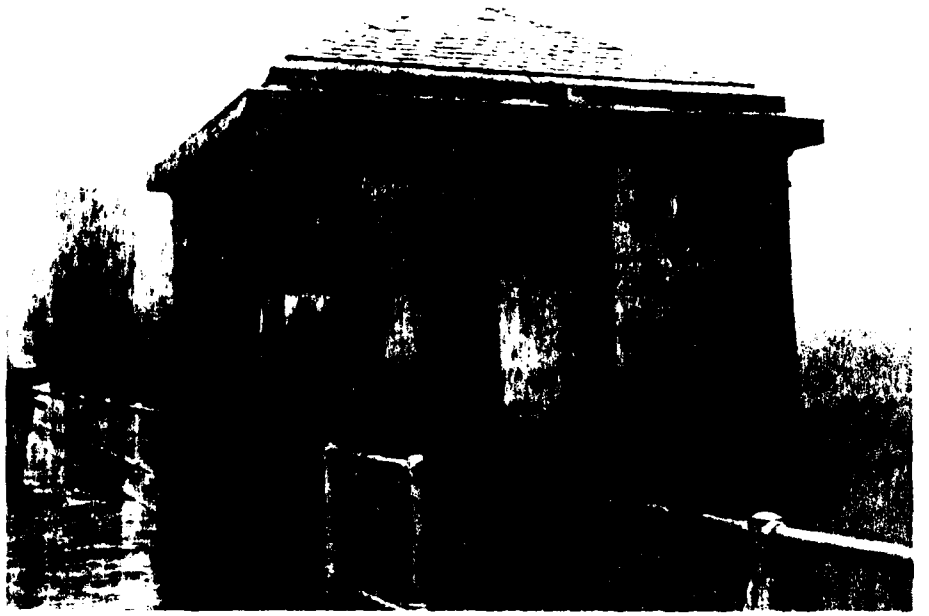


Photo 7

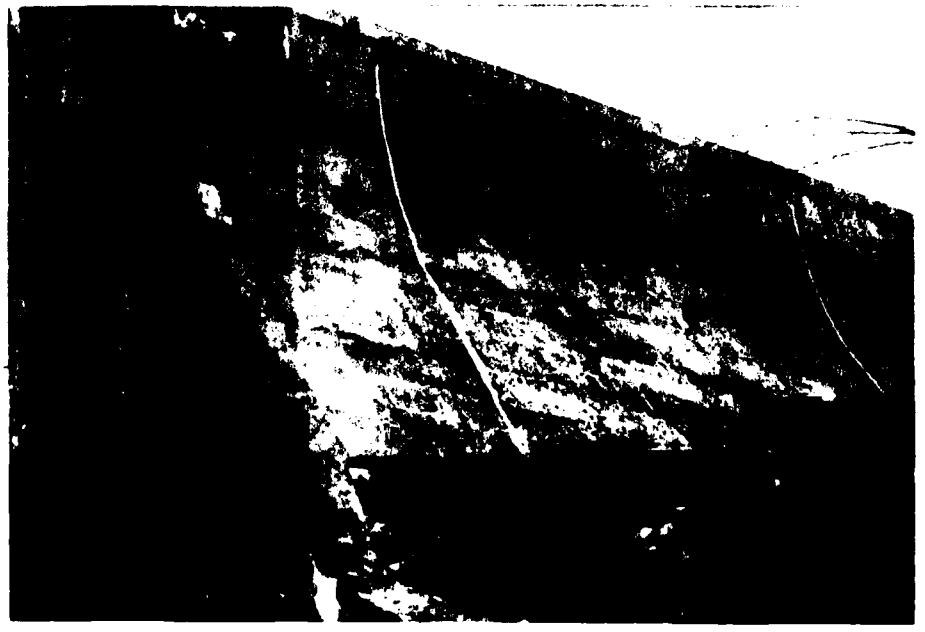
General view of gate house exterior condition.

Photo 8

Typical inspection well below landing.

nstream face of dam
left end.

stream face of dam
m left end.



stream face of dam,
, view from spill-
of.

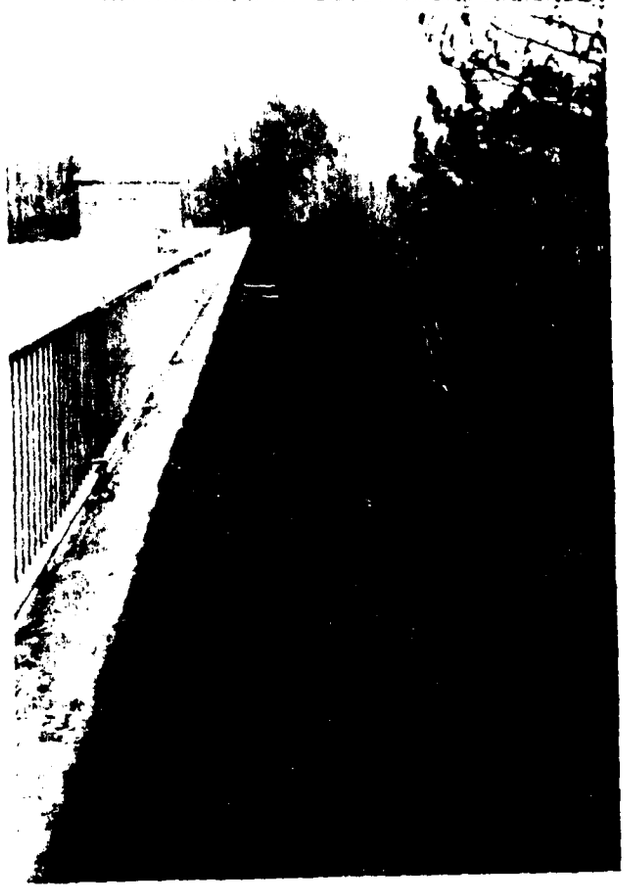


Photo 1

Downstream face of dam from right end.

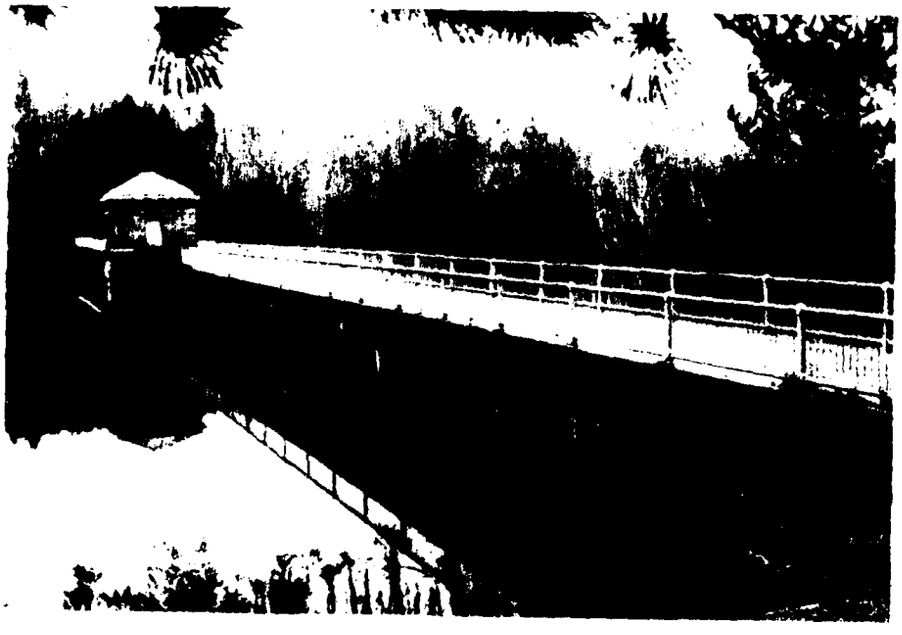
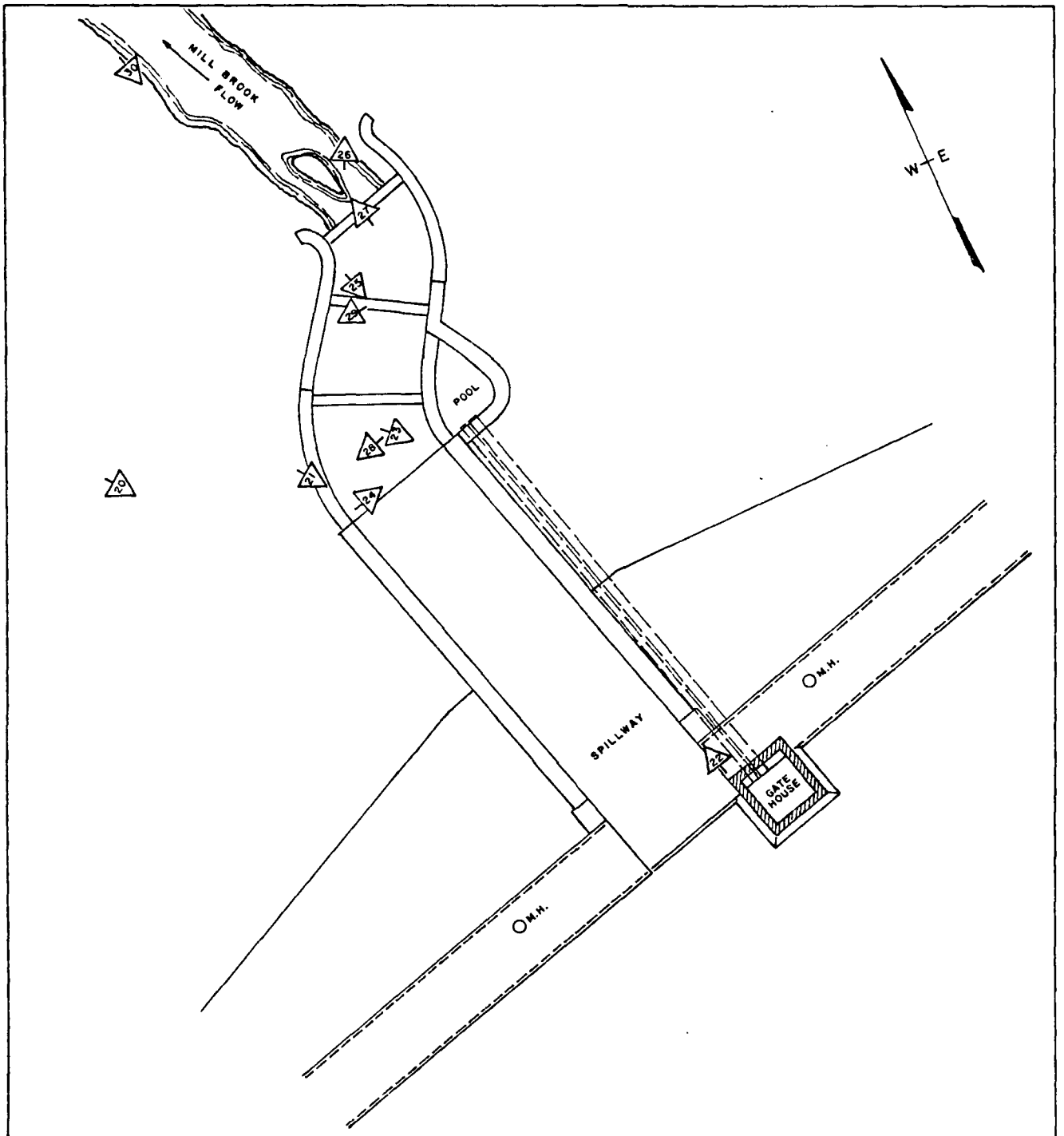


Photo 2

Upstream face of dam from right end.



TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

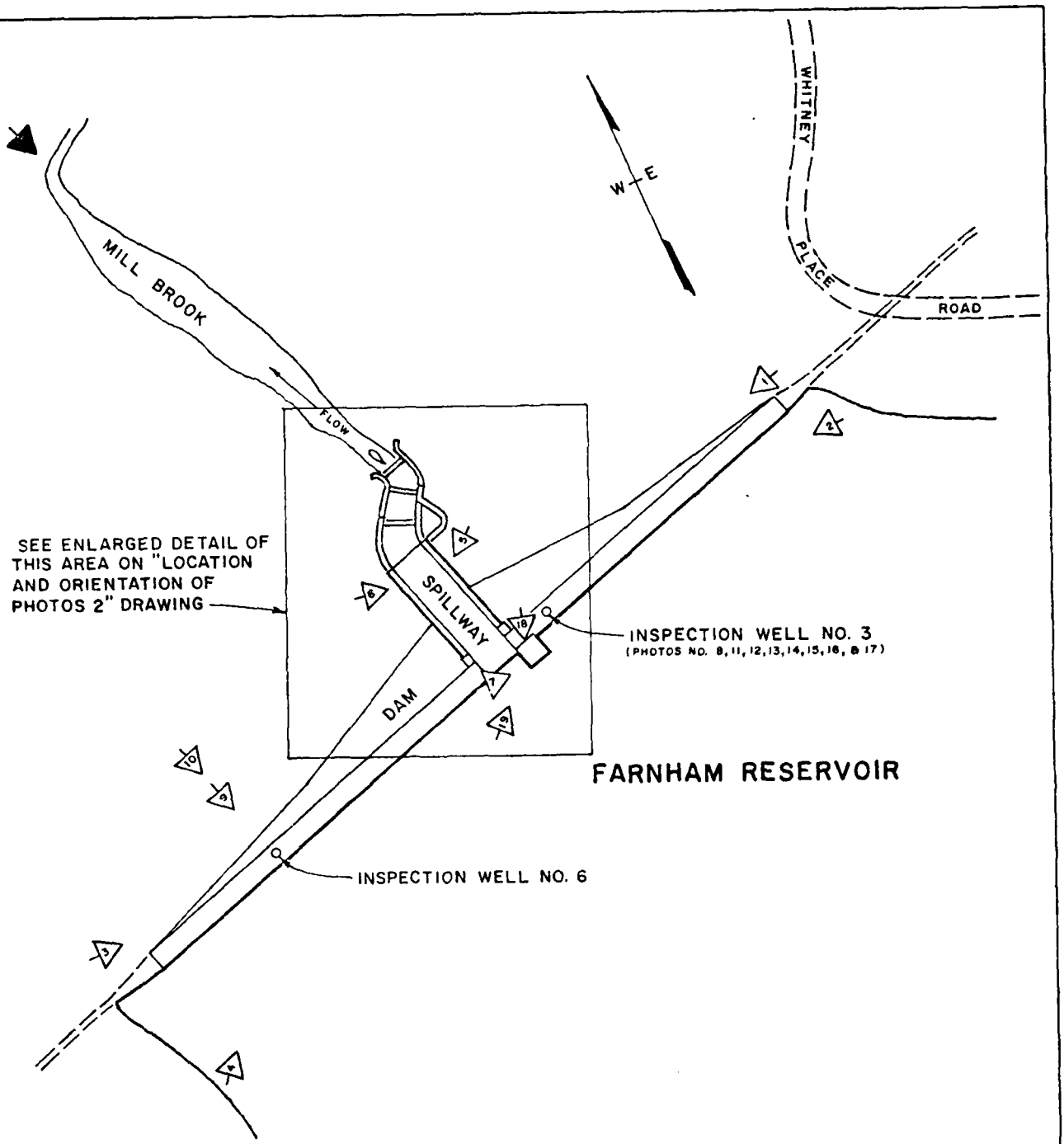
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS 2

FARNHAM RESERVOIR DAM (MA00314) WASHINGTON
BERKSHIRE COUNTY MASSACHUSETTS

			SCALE: NONE
			DATE: FEBRUARY 1980

APPENDIX C



OVERVIEW (AERIAL)

APPENDIX C

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS 1

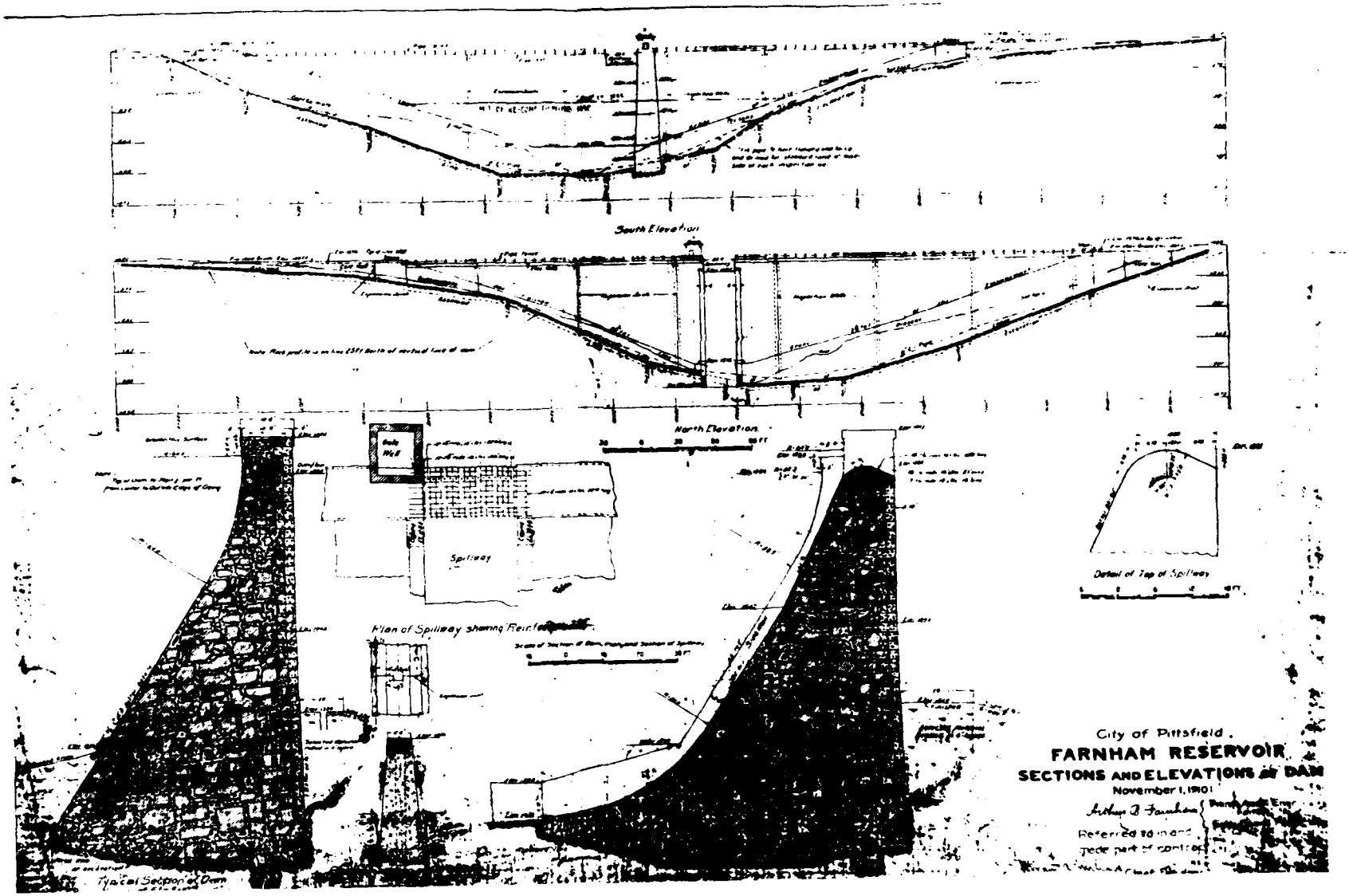
FARNHAM RESERVOIR DAM (MA00314) WASHINGTON
BERKSHIRE COUNTY MASSACHUSETTS

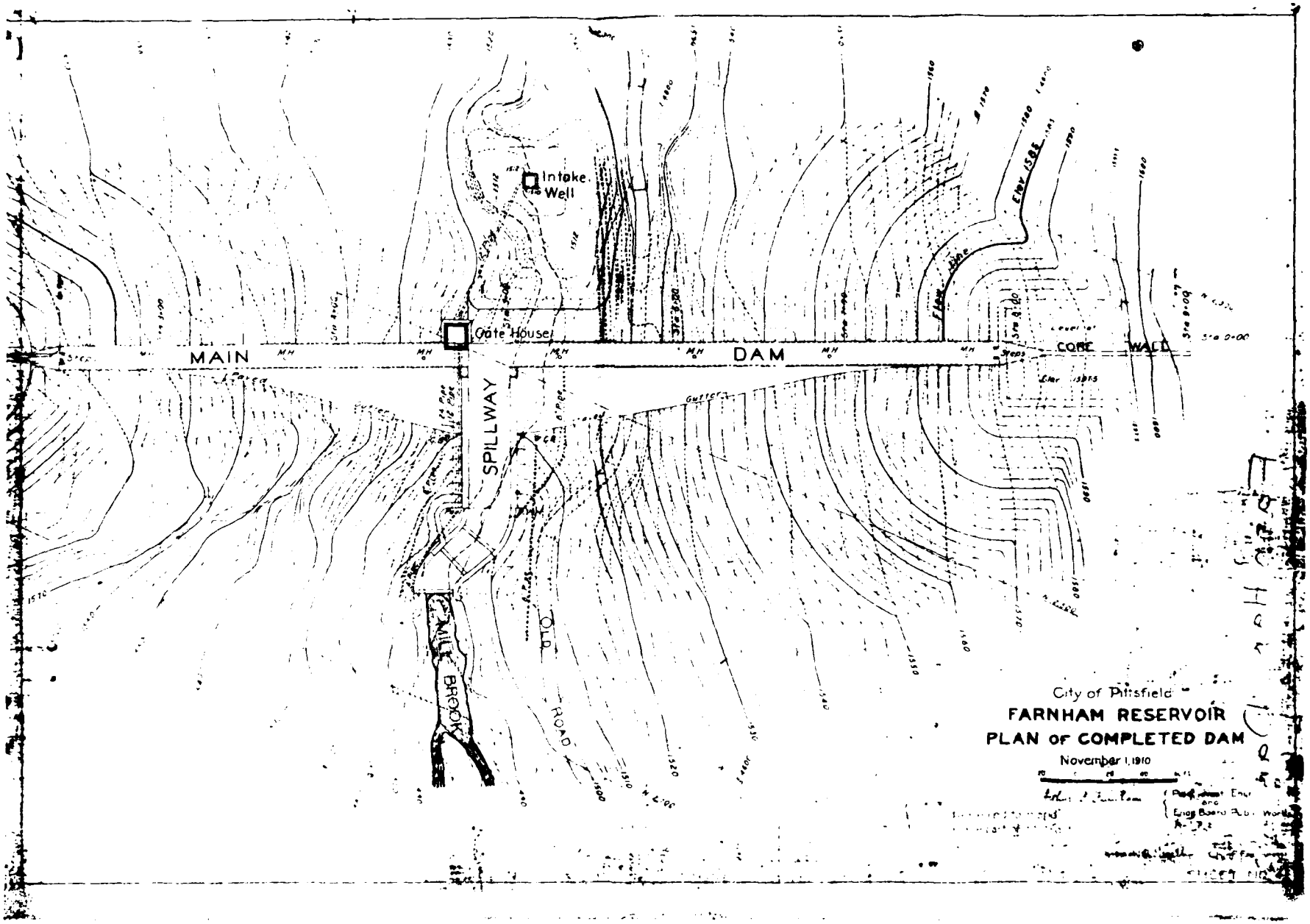
SCALE: NONE

DATE: FEBRUARY 1980

APPENDIX C

PHOTOGRAPHS





Design and construction information is located at the following places.

Item	Location
Plans of Farnham Dam	City of Pittsfield Department of Engineering
Plans and notes of recent reconstruction & changes	Metcalf & Eddy, Inc. 50 Staniford St., Boston, MA
Inspection Reports	Mr. John Hannon, Mass. DEQE, Waterways Division, 100 Nashua St. Boston, MA
Plans attached: Farnham Reservoir Plan of Complete Dam	Attached hereafter
Sections and Elevations of Dam	Attached hereafter

APPENDIX B

ENGINEERING DATA

INSPECTION CHECK LIST

PROJECT Farnham Dam DATE 11/7/79

PROJECT FEATURE Spillway NAME Tighe & Bond Party

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good, gunited
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	No
Floor of Approach Channel	Submerged
b. Weir and Training Walls	Weir in good condition Training wall of drop chute in good condition
General Condition of Concrete	Fair
Rust or Staining	At some gunite cracks
Spalling	Gunite covered
Any Visible Reinforcing	None, Mass cyclopean concrete
Any Seepage or Efflorescence	Considerable efflorescence at cracks in gunite
Drain Holes	Drain holes in gunite on floor of drop chute
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	Yes
Floor of Channel	Rebuilt of concrete which is now deteriorating and spalling off surface
Other Obstructions	Gunite coating is cracked, stained, with efflorescence. Water flow. 12" drain discharge pipe

INSPECTION CHECK LIST

PROJECT Farnham Dam — DATE 11/7/79

PROJECT FEATURE Spillway Bridge — NAME Tighe & Bond Party

DISCIPLINE _____ — NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	Concrete arch across spillway
Bearings	N/A
Anchor Bolts	N/A
Bridge Seat	N/A
Longitudinal Members	N/A
Under Side of Deck	All surfaces gunited
Secondary Bracing	N/A
Deck	Concrete at same elevation as top of dam
Drainage System	N/A
Railings	Good. Some rust but sound and generally well painted
Expansion Joints	N/A
Paint	Good. Few gaps and stains
b. Abutment & Piers	
General Condition of Concrete	Not visible, gunite covered
Alignment of Abutment	Good
Approach to Bridge	Good
Condition of Seat & Backwall	N/A

INSPECTION CHECK LIST

PROJECT Farnham Dam — DATE 11/7/79

PROJECT FEATURE Water Works Intake Tower — NAME Tighe & Bond Party

DISCIPLINE — NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Fair. Top of walls have spread ¼"± probably from roof thrust
General Condition	
Condition of Joints	Fair. Tight joints, 1/16" to 1/8"
Spalling	Some
Visible Reinforcing	None; gravity masonry construction
Rusting or Staining of Concrete	None
Any Seepage or Efflorescence	Efflorescence at most joints. No seepage
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	Submerged, not visible
Cracks	Top of walls
Rusting or Corrosion of Steel	None
b. Mechanical and Electrical	
Air Vents	Windows & door
Float Wells	8 in. pipe through floor. 9.7'+ .54'-.17"=10.1 floor to water level in wet well
Crane Hoist	Hoist beam and hook in place. No hoist
Elevator	None
Hydraulic System	None
Service Gates	4 Inlet gate valves; 2-20", 1-24", 1-12" 1-24" and 1-12" outlet side
Emergency Gates	None Security cable & lock to prevent unauthorized operation.
Lightning Protection System	None
Emergency Power System	Hand operated gate valve wheels
Wiring and Lighting System in Gate Chamber	None

Photo 11

Inspection well No. 3, showing crack in concrete below manhole frame east side.

Photo 12

Inspection well No. 3, showing crack in concrete below manhole frame west side.

Photo 13

Solid steel guardrail and concrete condition at landing of inspection well No. 3.

Photo 14

Concrete crack in inspection well No. 3 at top of landing showing increasing crack width at top.

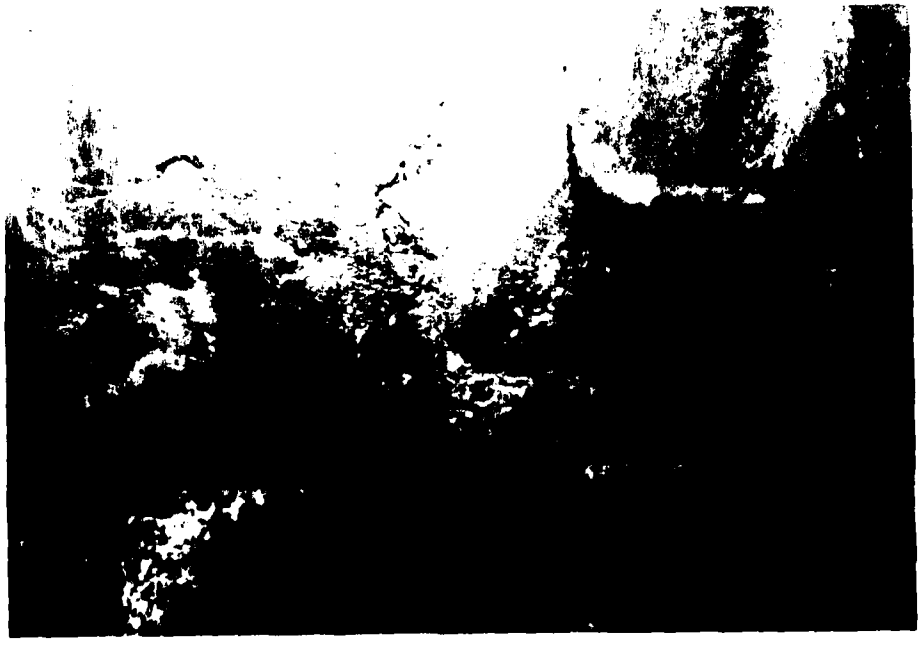


Photo 15

Concrete deterioration at floor of inspection well landing.

Photo 16

Concrete crack and efflorescence in inspection well No. 6.

Photo 17

Spauling and displacement at expansion joint in inspection well No. 6.

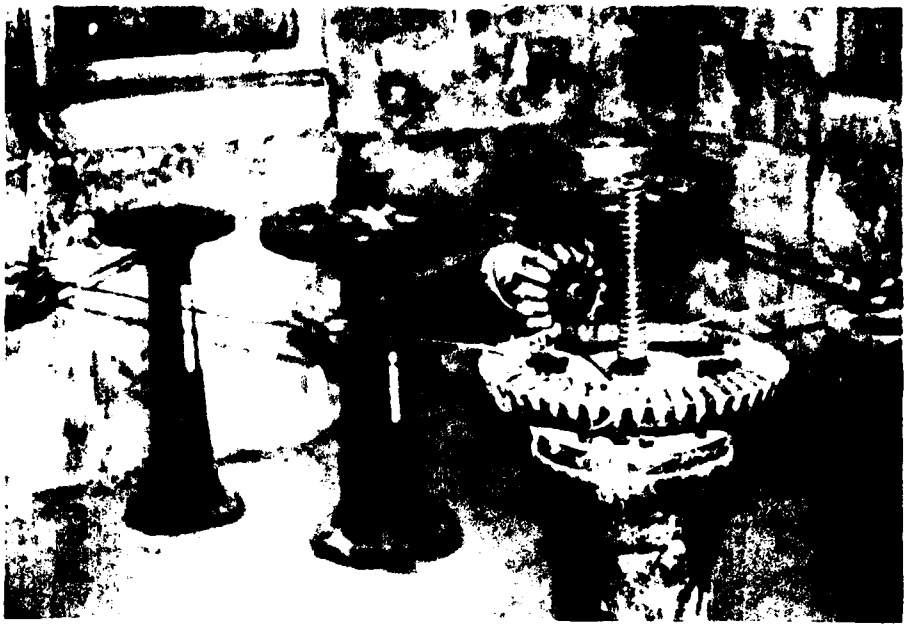


Photo 18

Operating handwheels for outlet gates.

Photo 19

Stoplogs and guides on spillway crest.

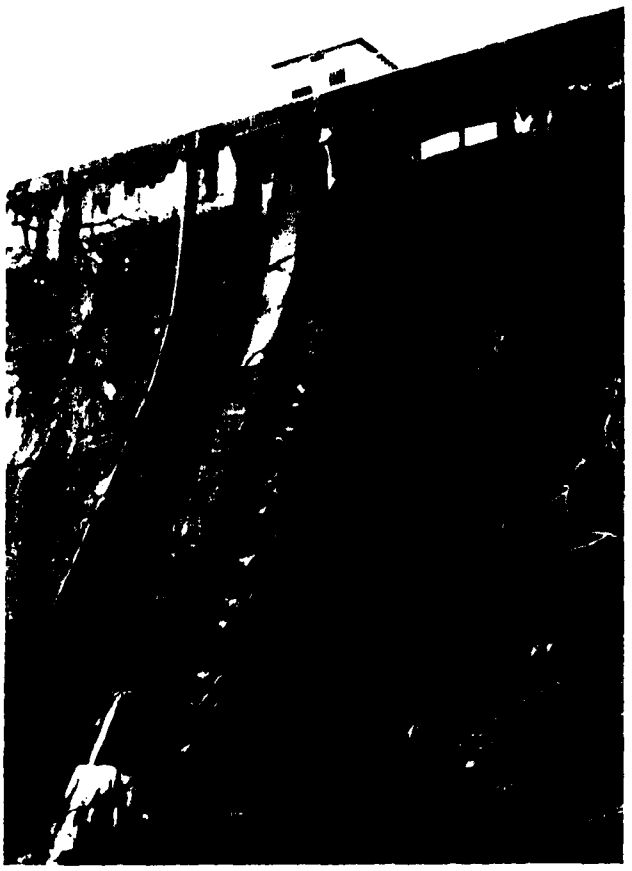


Photo 20

Spillway chute, upper end.

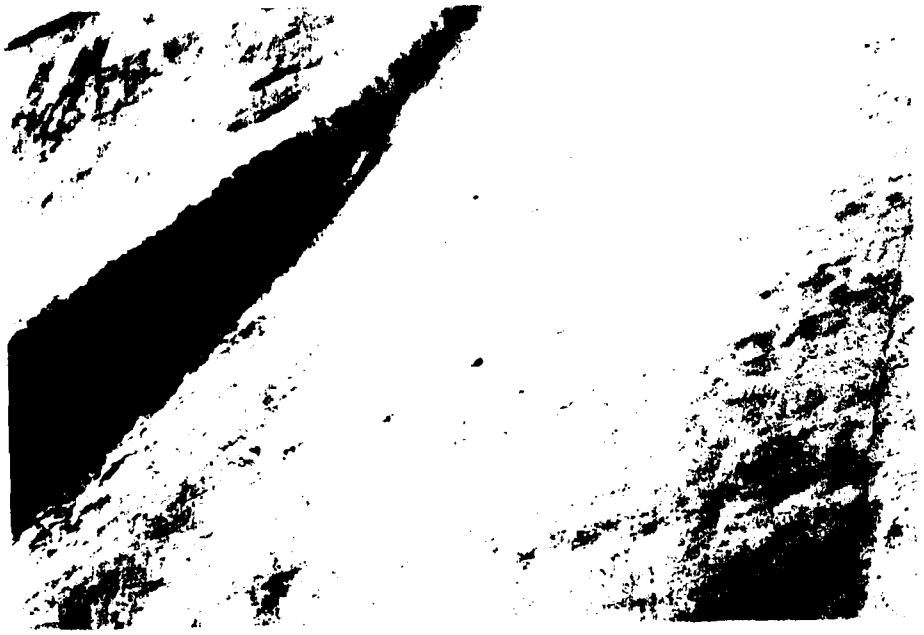


Photo 21

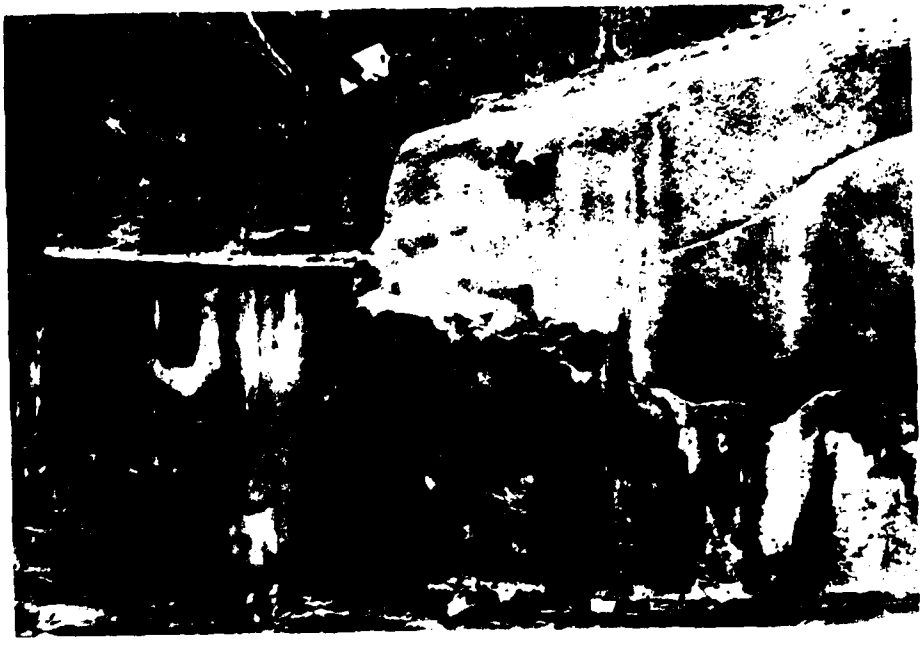
Spillway chute, showing weep holes through gunite.

Photo 22

Lower end of spillway chute and outflow channel.

Photo 23

Spillway chute right [illegible] wall.



[illegible]

Spillway, right wall at [illegible] outlet stilling [illegible].

Photo 25

Spillway outlet, right guidewall showing gate-wall drain outlet.

Photo 26

End of right spillway guide wall and right toe drain outlet.

Photo 27

Stream channel downstream from end of spillway channe

Photo 28

spection wells drain outlet
left spillway outlet
annel guidewall.

oto 29

ft spillway outlet guide-
ll showing weep holes in
paired wal'.

Photo 30

Left toe drain outlet and
downstream channel.

APPENDIX D

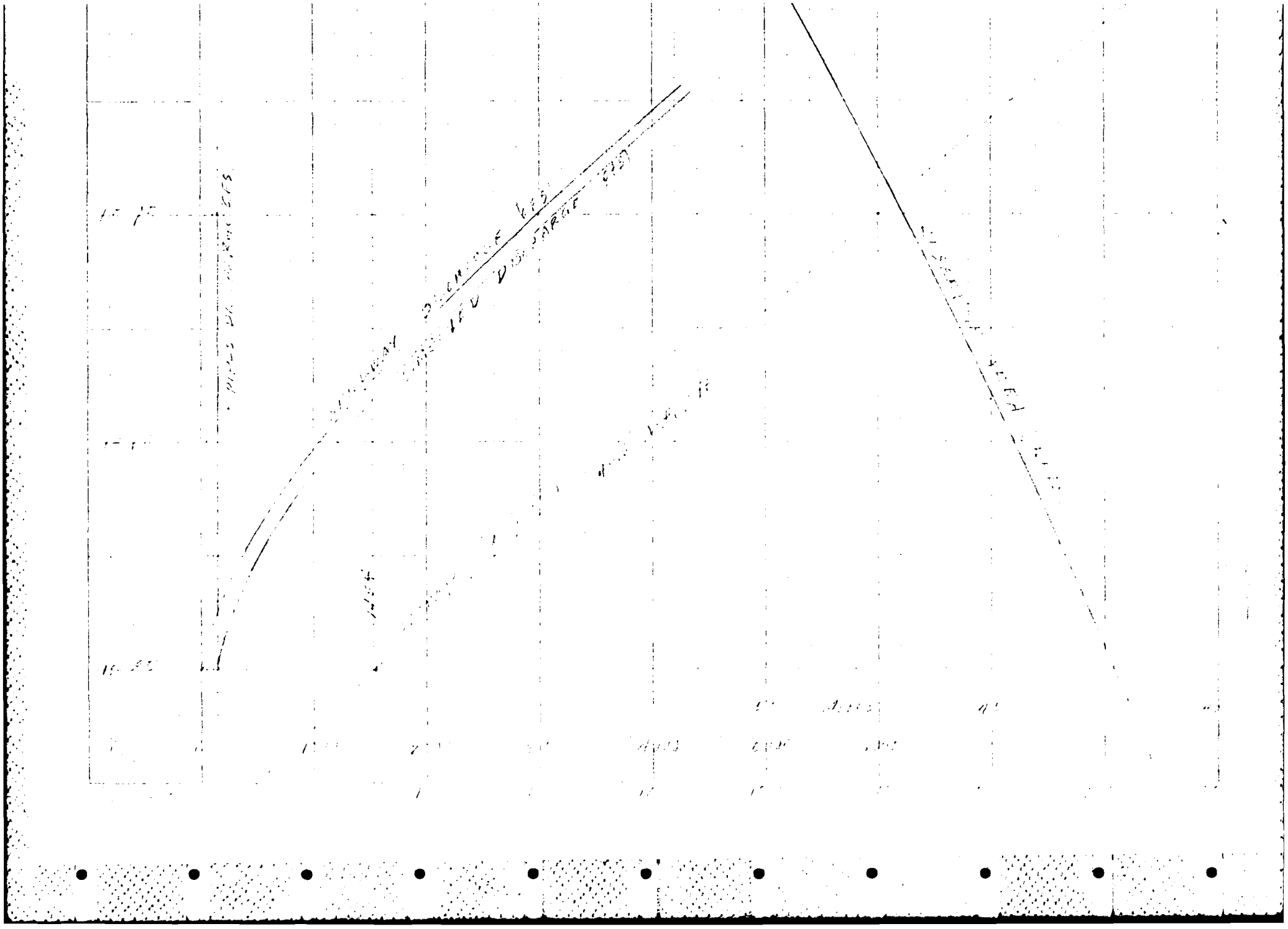
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

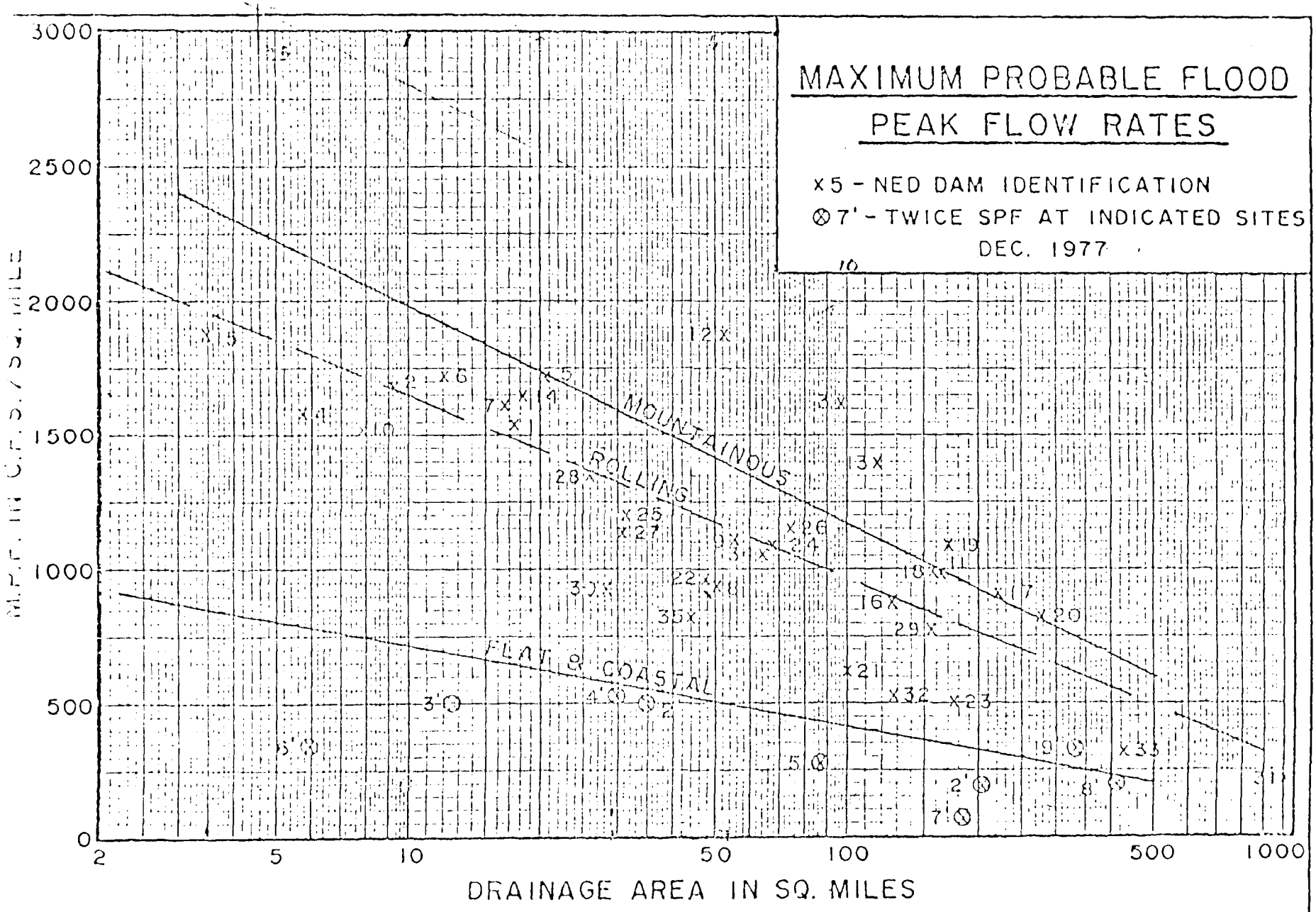
APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

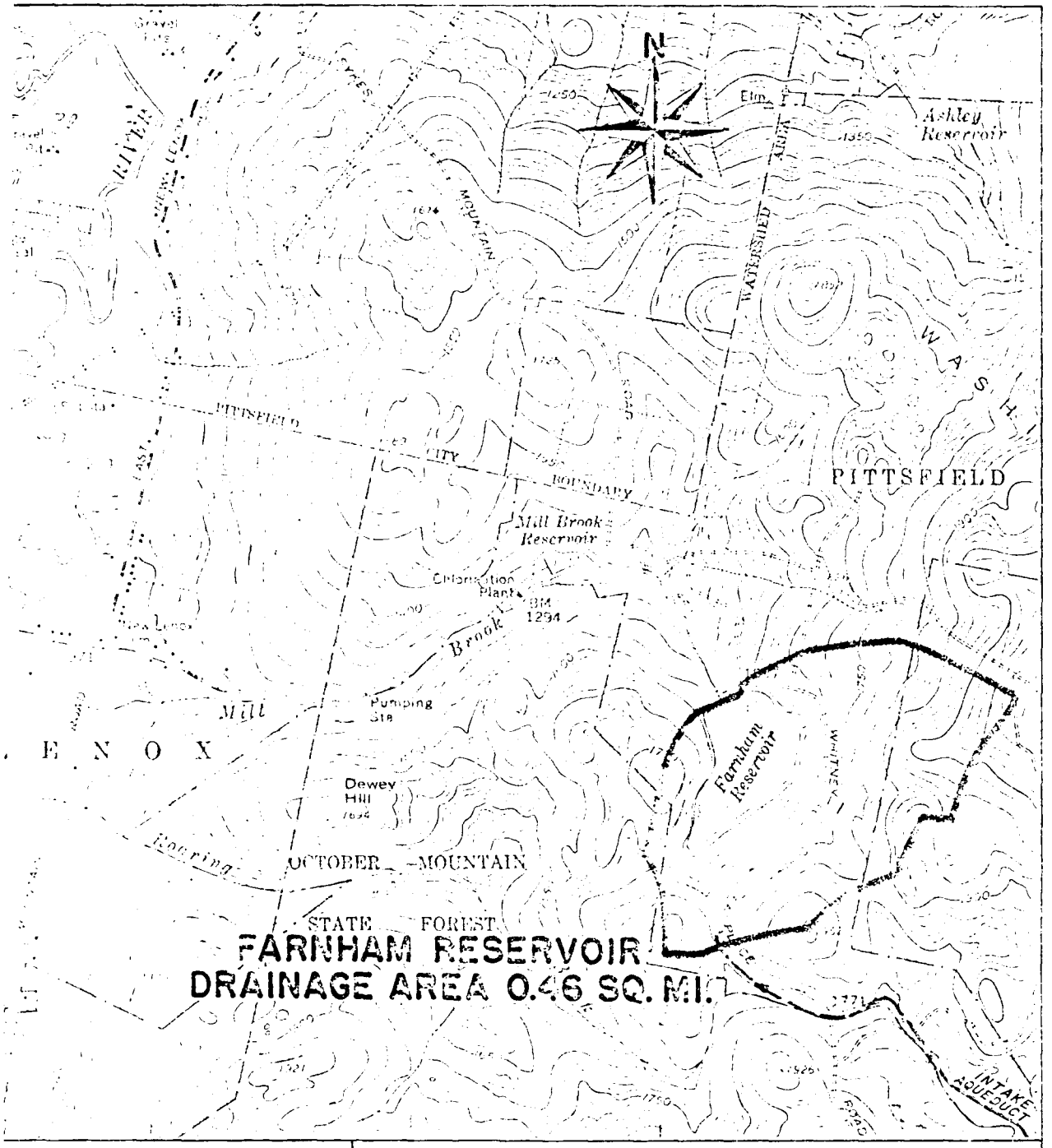
Index

Item	Page
Location	1/4
Drainage Area	1/4
Discharge Works Capacity	1/4
Reservoir Stage Capacity	2/4
Reservoir Stage Area	2/4
Spillway Stage Discharge	2/4
Size Classification	3/4
Hazard Classification	3/4
Spillway Test Flood	3/4
Maximum Probable Flood	4/4
Dam Failure Discharge	1/13
Dam Failure Flood Routing to Housatonic River	1 to 4/13
Dam Failure Flood Impact on Housatonic River	4 to 10/13
Downstream Hazard Map	11 & 12/13
Dam Failure Impact Table	13/13
Experience Data	

Spillway crest							
Top of dam							
Test #10	1569.3 ±3	344	99	36.2	99	107	457




MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
MOUNTAINOUS
ROLLING
FLAT & COASTAL
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000



-SCALE-

00' 0 1000' 2000' 3000'

FROM: U.S.G.S. PITTSFIELD EAST, MASS. QUADRANGLE MAP

QUADRANGLE LOCATION

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

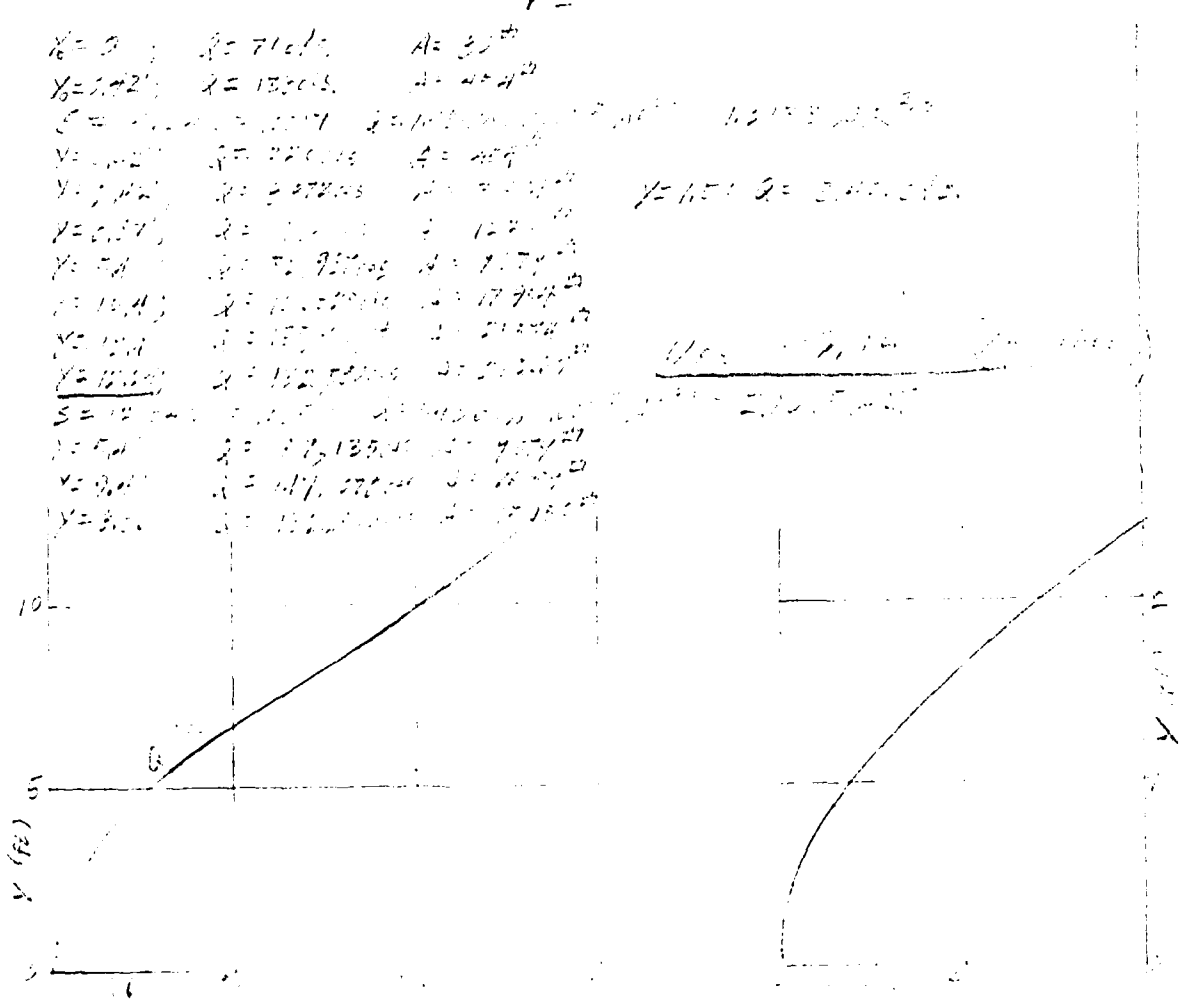
DRAINAGE AREA MAP

FARNHAM RESERVOIR DAM (MA 00314) WASHINGTON
BERKSHIRE COUNTY MASSACHUSETTS

			SCALE: AS NOTED
			DATE: FEBRUARY 1980

Summary [illegible] 13 [illegible]

Map Location No.	Distance Downstream from Dam ft.	Feature	[illegible]	Before Failure Flow cfs / Elevation	Before Failure: Depth Overtopped ft.	Elev. Damaged	After Failure: Flow cfs / Elevation	Depth Overtopped ft.	Elev. Damaged	Comments
1	0	Dam	1	944 / 3'	0	0	236,440 / 37	17	1	[illegible]
2	[illegible]	Mill Pond [illegible] (breached)	-	944 / 3'	0	0	199,945 / 34	4	[illegible]	Breached dam [illegible] collapse; [illegible] destroyed by [illegible]
3	[illegible]	[illegible] Road	2	944 / 3	0	0	132,150 / 18	9	2	Road [illegible] destroyed by [illegible]
4	11,300	[illegible]	35	1164 / 4	0	0	6,000 / 7 / 51,900	0	[illegible]	[illegible]
5	32,000	[illegible]	[illegible]	1164 / 3	0	0	6,300 / 9	[illegible]	[illegible]	[illegible]


10
5
Y (ft)

Dam Failure [illegible] 8/13 [illegible]

What will the [illegible] of [illegible] MPF
before [illegible] Lower [illegible]
& MPF [illegible]

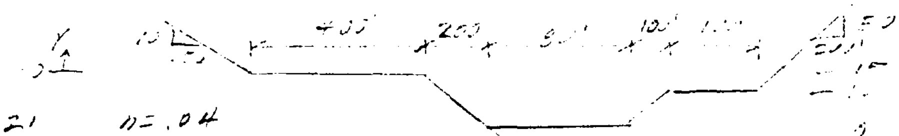
Storage [illegible] 91. + 7392 = 113 [illegible]

Depth to store Dam break = 1672 [illegible] 1.4
Discharge with this storage
Y_2 = 16.2 + 1.4 = 17.6 q = 198,0[illegible]

Velocity at [illegible] = 144,300 / 24,275 = 5.94 = 21,380 [illegible]

Distance from [illegible] Brook to backwater control at dam = 22,000 ft
This change in depth will

MPF at river control at Walker St. Lower Dam.



S = .0021 n = .04
A = [illegible] + 10 x (5+15)/2 [illegible] + 4(5)^2/2 + [illegible] + 840 y + [illegible]

= 1200 + 100 + 500 [illegible] 2y^2 150 + 8 [illegible] = 4250 + [illegible]

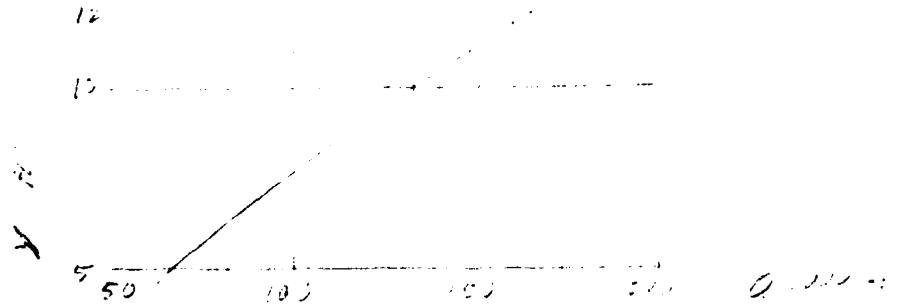
P = 1544 [illegible] + 100 + [illegible] = [illegible] 14.1

R = [illegible]

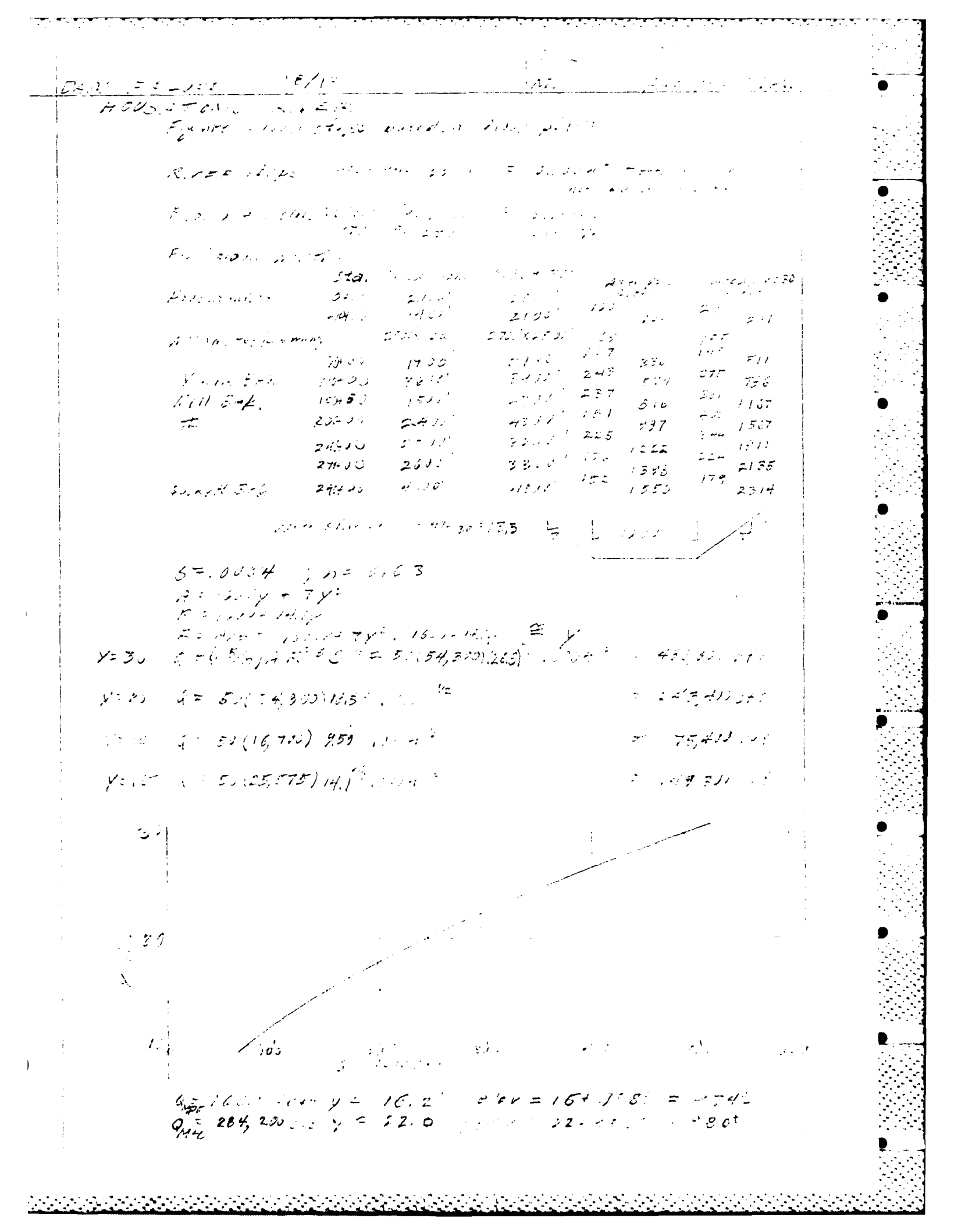
Y=5 q = [illegible] 8,334 [illegible] 9.1 [illegible] = 6[illegible] cfs

Y=10 q = 37.5 (14,00[illegible]) 13.1 [illegible] = 133,420 cfs

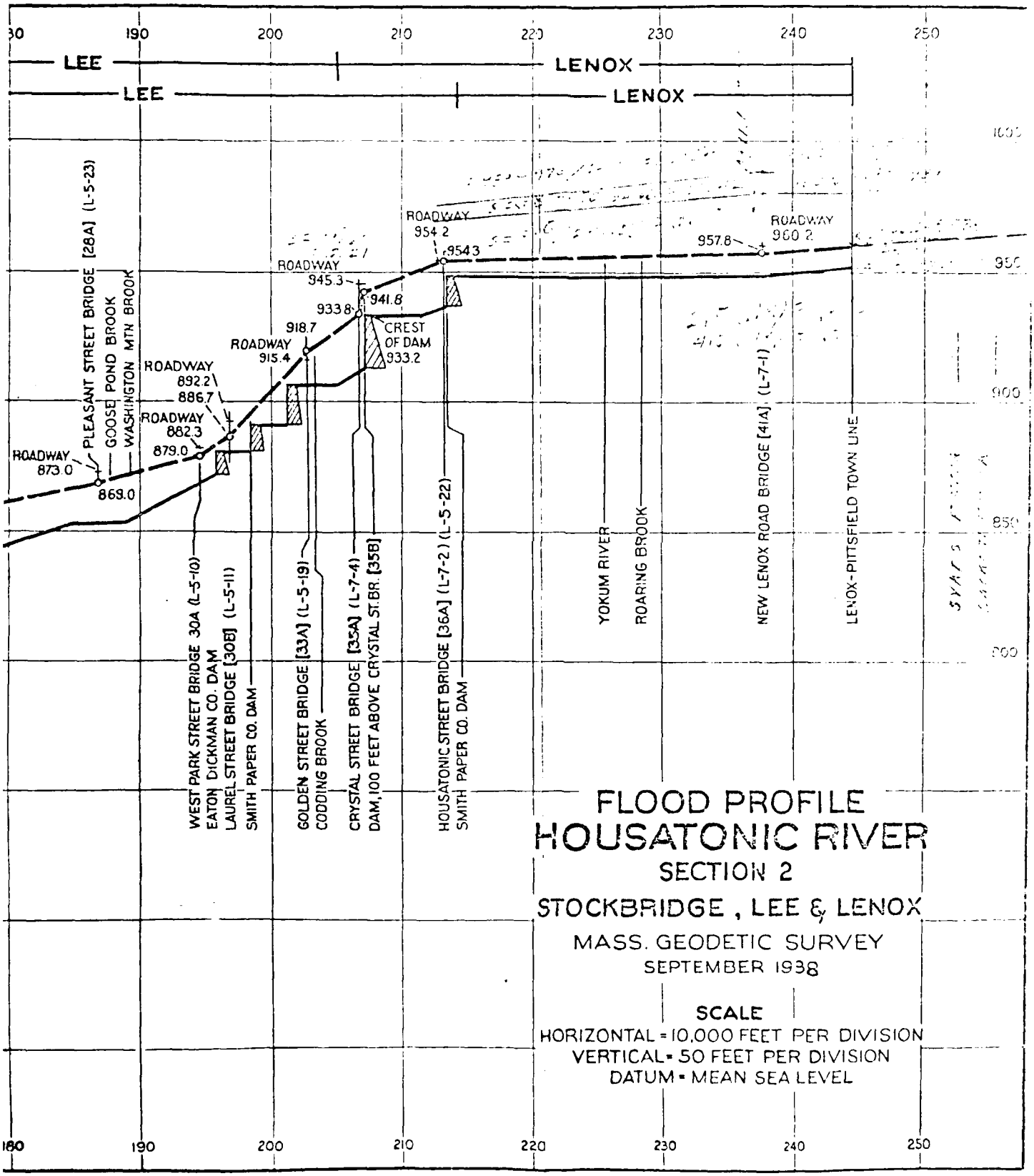
Y=12 q = 37.5 16,175 14.6 [illegible] = 105,380 cfs



Q = 16[illegible] [illegible] = 11.[illegible] [illegible] above BR [illegible]
MPF + Dam failure Y = 11.9 + 1.4 [illegible] Q = [illegible]
[illegible] 14.



DAM FAILURE T.I.E.



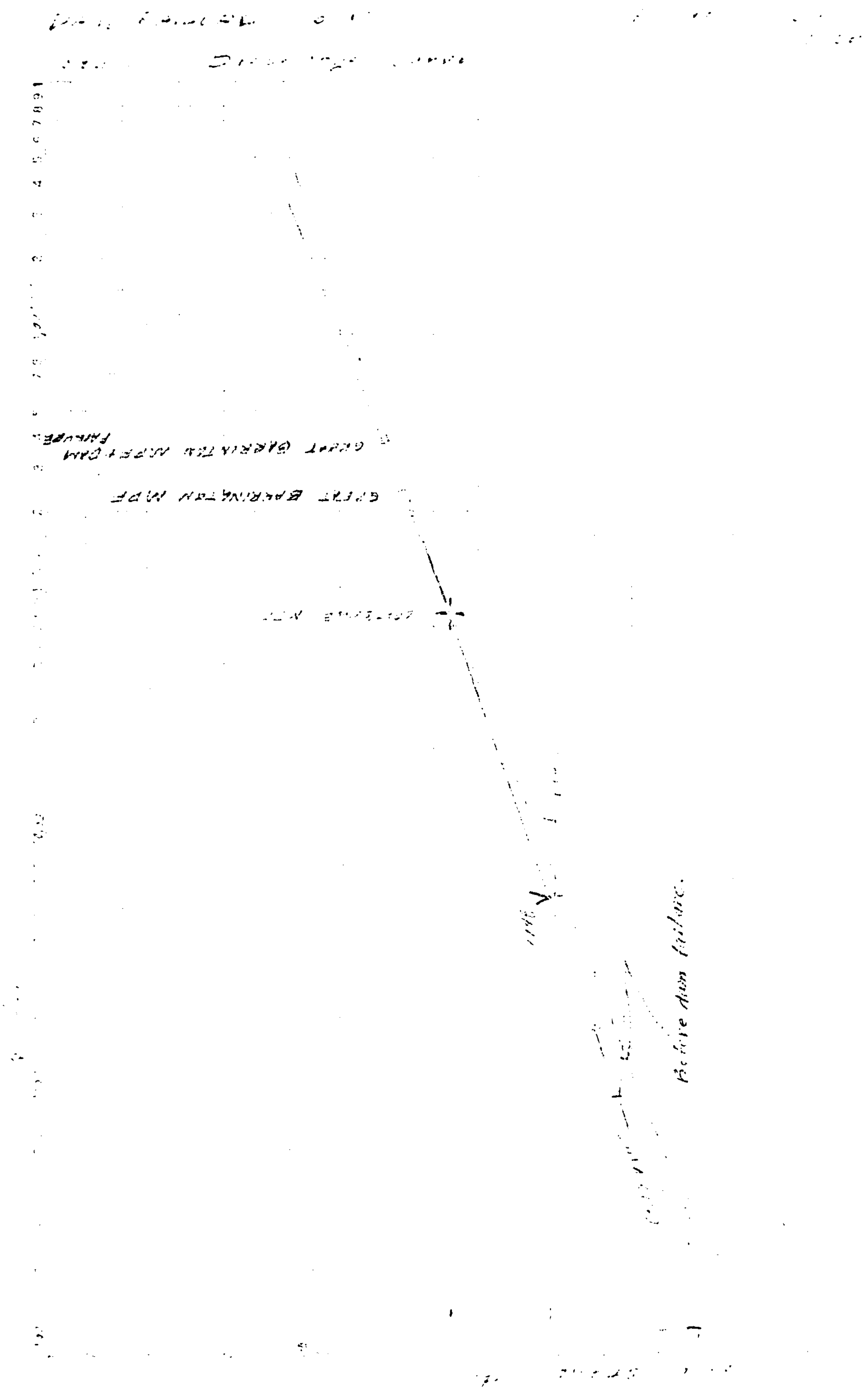
FLOOD PROFILE
HOUSATONIC RIVER
SECTION 2
STOCKBRIDGE, LEE & LENOX

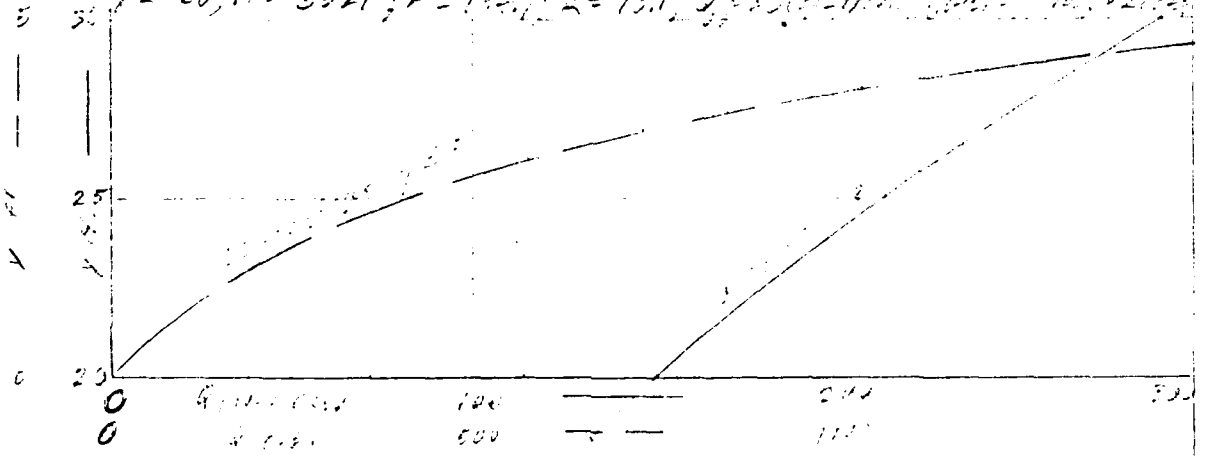
MASS. GEODETIC SURVEY
SEPTEMBER 1938

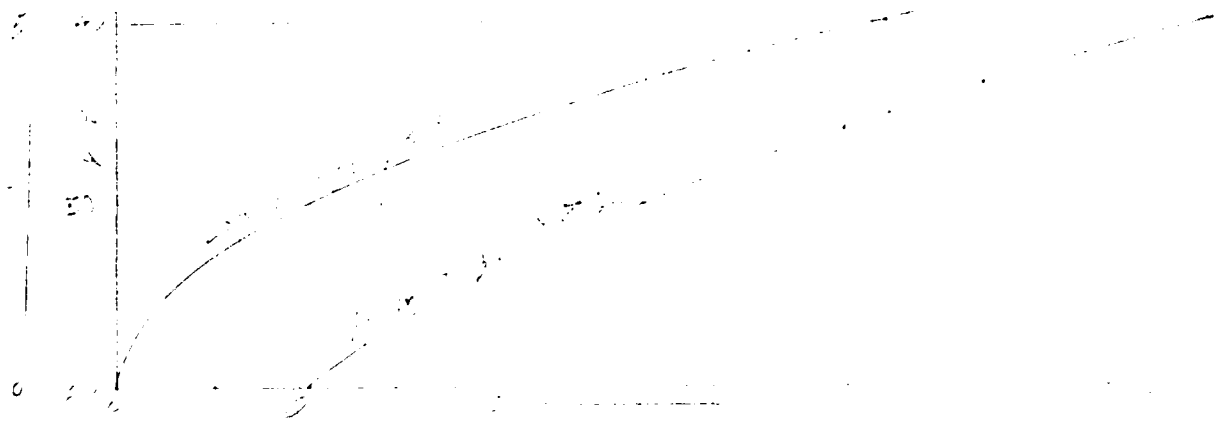
SCALE
HORIZONTAL = 10,000 FEET PER DIVISION
VERTICAL = 50 FEET PER DIVISION
DATUM = MEAN SEA LEVEL

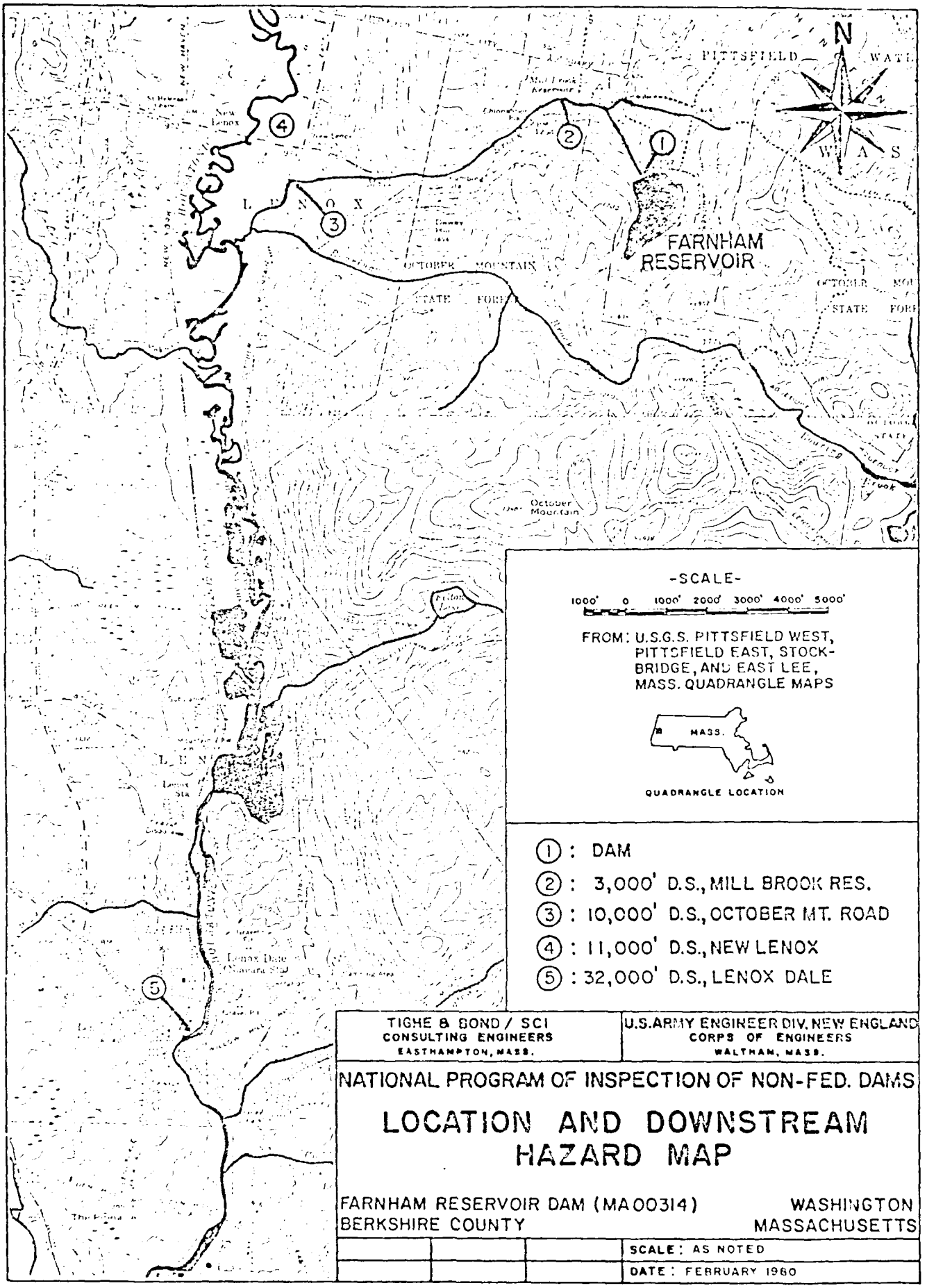
Lib. #60.5.5

HCR II


Before dam failure







-SCALE-

1000' 0 1000' 2000' 3000' 4000' 5000'

FROM: U.S.G.S. PITTSFIELD WEST, PITTSFIELD EAST, STOCKBRIDGE, AND EAST LEE, MASS. QUADRANGLE MAPS

QUADRANGLE LOCATION

① : DAM
② : 3,000' D.S., MILL BROOK RES.
③ : 10,000' D.S., OCTOBER MT. ROAD
④ : 11,000' D.S., NEW LENOX
⑤ : 32,000' D.S., LENOX DALE

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

FARNHAM RESERVOIR DAM (MA00314) WASHINGTON
BERKSHIRE COUNTY MASSACHUSETTS

			SCALE: AS NOTED
			DATE: FEBRUARY 1980

Selected data for locations in the same area as Farnham Dam:

Reference: Yield of Streams in Massachusetts, Water Resources Research Center, University of Massachusetts, Amherst, Massachusetts.

Station	D.A. sq. mi.	cfs/mi	cfs	Date	Record
Green River Gt. Barrington, MA	5.2.2	40	2,120	3/31/60	1951-62
Reference: U.S.G.S. Water Data Report CT-25-a					
Salmon Creek Lime Rock, CT	29.4	214	6,300	8/19/55	From high wtr marks
	29.4	44	1,300	12/21/73	1961-1975
Guinea Brook Ellsworth, CT	3.5	91	319	12/21/73	1960-1975
Applied to Farnham Dam	0.5	400	200	8/19/55	Maximum reported reservoir depth

Flood runoff data indicates that 200 cfs inflow to Farnham Dam may have been likely in August 1955.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

314	NED	MA	003	01			FARNHAM DAM	4223.5	7312.5	16FEB80

POPULAR NAME	NAME OF IMPOUNDMENT
	FARNHAM RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	10	MILL BROOK	LENOX DALE	4	1500

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE–FT.)
PGOT	1910	S	105	99	1900	1455

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	

REMARKS
21 CONCRETE

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	750	U	24	3000												

OWNER	ENGINEERING BY	CONSTRUCTION BY
PITTSFIELD WATER DEPT	PITTSFIELD ENG DEPT	CITY OF PITTSFIELD

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
MASS DEQE DIV WATR	MASS DEQE DIV WATR	NONE	MASS DPW

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
TIGHE & BOND DIV OF SCI	07NOV79	PL92-367

REMARKS

REPORTS CONTROL SYMBOL
DAEN–CWE–17

END

FILMED

7-85

DTIC